VOLUME XXI MAY, 1938 NUMBER 5

JOURNAL OF DAIRY SCIENCE

PUBLISHED BY THE
AMERICAN DAIRY SCIENCE ASSOCIATION

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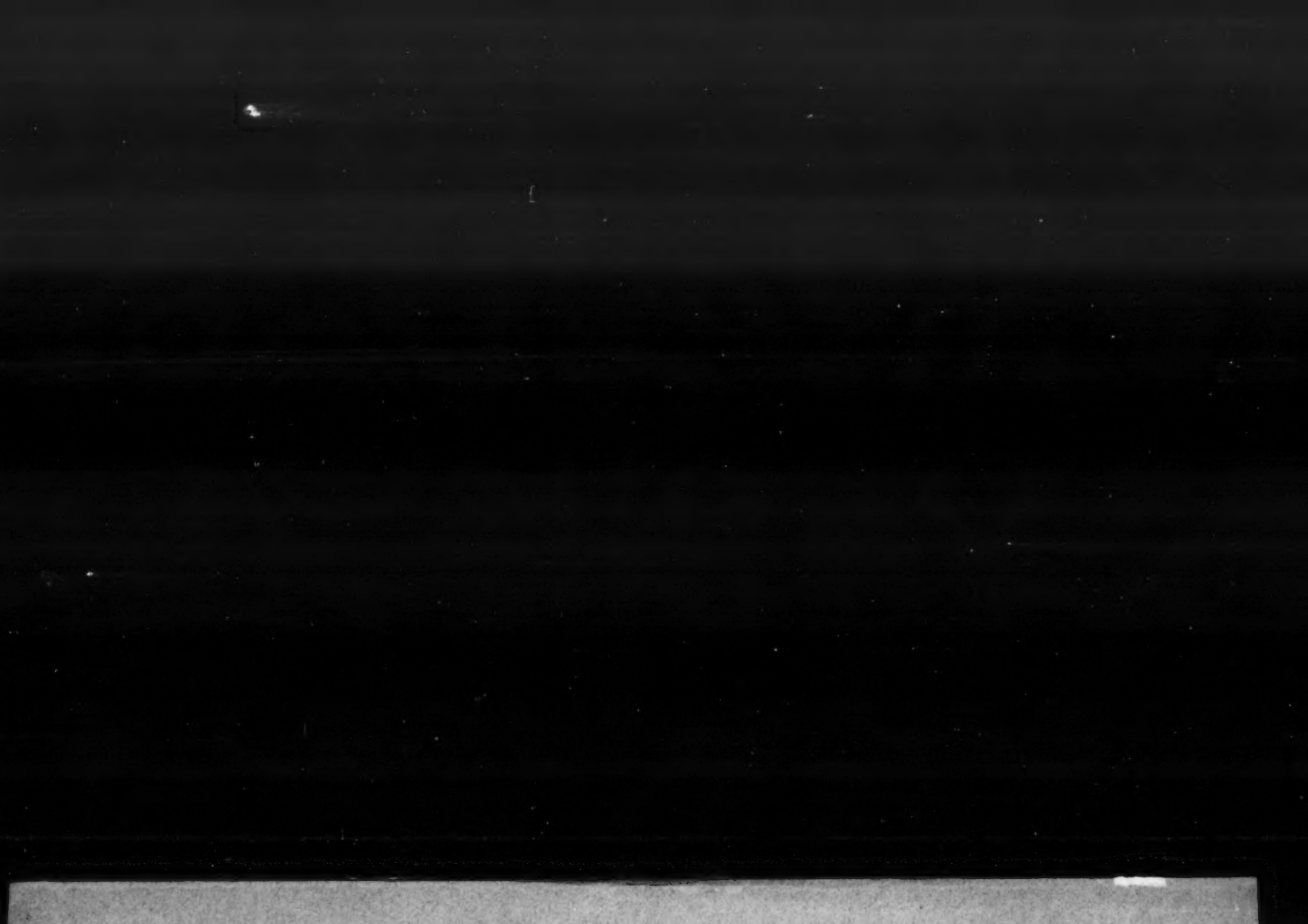

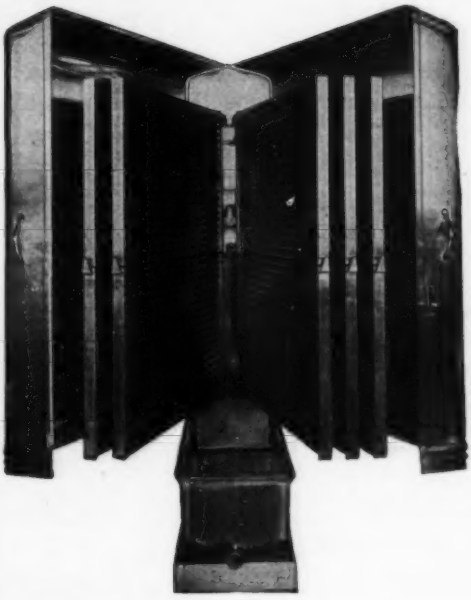

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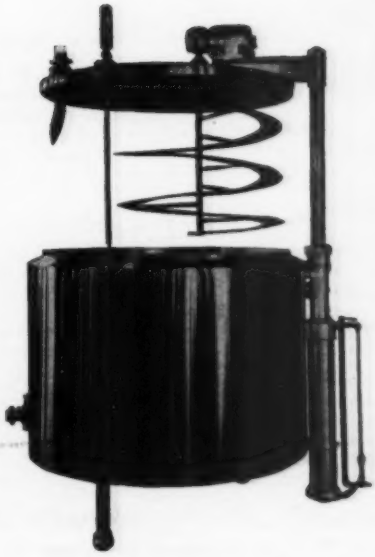

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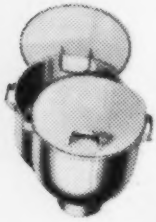

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Eliminates filthy contamination by flies, also protects against stable dust and odors. No. 61, 13½". No. 65, 15".

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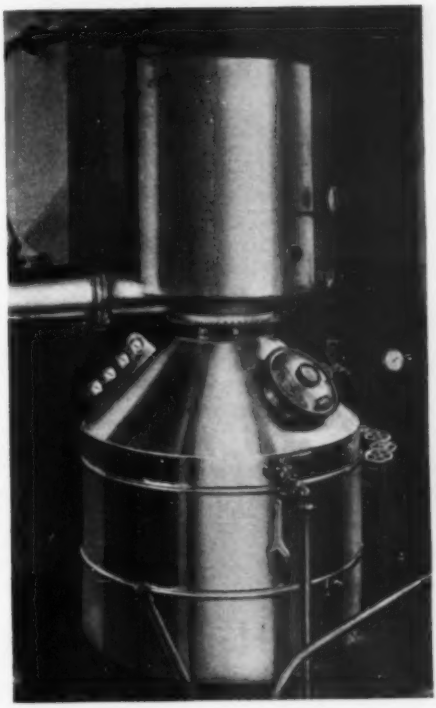

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JOURNAL OF DAIRY SCIENCE

VOLUME XXI MAY, 1938 NUMBER 5

PROGRAM

THIRTY-THIRD ANNUAL MEETING
THE AMERICAN DAIRY SCIENCE ASSOCIATION

THE OHIO STATE UNIVERSITY
COLUMBUS, OHIO

JUNE 14–15–16, 1938

AND

OHIO AGRICULTURAL EXPERIMENT STATION
WOOSTER, OHIO

JUNE 17, 1938

PROGRAM COMMITTEE

C. J. BABCOCK, United States Department of Agriculture
E. N. SHULTZ, American Guernsey Cattle Club
W. E. KRAUSS, Ohio Agricultural Experiment Station
H. P. DAVIS, (Advisory Member), University of Nebraska
S. I. BECHDEL, (Advisory Member), Pennsylvania State College
T. S. SUTTON, (Chairman), Ohio State University

AMERICAN DAIRY SCIENCE ASSOCIATION

The Thirty-third Annual Meeting

Columbus, Ohio, June 14–16, 1938

AND

Wooster, Ohio, June 17, 1938

GENERAL PROGRAM

Monday, June 13

1 P. M.–4 P. M. General Registration and Room Registration, Pomerene Hall. Dormitory rooms will not be available until Tues., June 14. Hotel and other rooms available June 13.

5 P. M. Visitors on the Ohio State Campus are cordially invited to attend the Convocation Exercises of the University, Ohio Stadium.

Tuesday, June 14

8 A. M.–9 P. M. General Registration and Room Registration, Pomerene Hall.

10 A. M.–12 NOON Opening Session, Campbell Hall Auditorium, 200. H. W. Gregory, presiding.
Address of Welcome:
George W. Rightmire, President, Ohio State University.
Response and Address:
H. W. Gregory, President, American Dairy Science Association.
Address.

1 P. M.–2:30 P. M. General Session (Education), Campbell Hall Auditorium, 200.
(1) The New Education, Dean Arthur J. Klein (by Invitation) College of Education, Ohio State University.
(2) Measuring the Results of Instruction in the Dairy Sciences. R. W. Tyler (by Invitation), Bureau of Educational Research, Ohio State University.
(3) Summer Practicum in Dairy Husbandry. A. A. Borland, Pennsylvania State College.
(4) A Service Course in Dairying for Home Economics Students. K. M. Renner, Texas Technological College.

2:30 P. M.–4:30 P. M. Manufacturing Section, Dairy Laboratories, Townshend Hall.
Judging Conference for Coaches and Instructors only, L. H. Burgwald and J. H. Erb in charge.

2:30 P. M.–4:30 P. M. Production and Extension Sections Combined, Campbell Hall Auditorium, 200.

Symposium on Nutrition.

4:30 P. M. Meeting of the Board of Directors, Campbell Hall, 203.

SECTIONAL COMMITTEE MEETINGS

4:30 P. M. Testing Committee of the Extension Section and Breeds Relations Committee of the Production Section (Combined Meeting). Horticulture and Forestry Bldg., 208. C. M. Shepardson and Floyd Johnson (Chairmen).

MANUFACTURING SECTION

Chemical Methods for the Analysis of Milk and Dairy Products, Campbell Hall, 216. L. C. Thomsen (Chairman).

Methods for the Bacteriological Analysis of Milk and Dairy Products, Campbell Hall, 217. H. Macy (Chairman).

Commitee on Quality Program, Campbell Hall, 218. W. H. E. Reid (Chairman).

Committee on Feasibility of Establishment and Maintaining a Loose-leaf Manual of Laboratory Methods, Campbell Hall, 215. H. Macy (Chairman).

Committee on the Judging of Dairy Products. Campbell Hall, 204. G. Malcolm Trout (Chairman).

Committee on Methods of Determining the Curd Tension of Milk, Campbell Hall, 102. L. H. Burgwald (Chairman).

Committee on Score Cards for Sanitary Inspection of Dairy Farms and Milk Plants, Campbell Hall, 303. C. J. Babcock (Chairman).

Committee to Study Methods for Measuring the Oxidation of Milk Fat, Campbell Hall, 304. O. F. Garrett (Chairman).

PRODUCTION SECTION

Committee on Rules for the Conduct of the Students' National Contest in Judging Dairy Cattle, Botany and Zoology Bldg., 110. I. W. Rupel (Chairman).

Committee on Awards for the Students' National Contest in Judging Dairy Cattle, Botany and Zoology Bldg., 208. A. A. Borland (Chairman).

Committee on Methods of Measuring Results of Pasture Investigations, Botany and Zoology Bldg., 209. R. H. Lush, (Chairman).

Committee on Standard Methods, Botany and Zoology Bldg., 100. A. E. Perkins, Chairman.

These same rooms will be available for a continuation of committee meetings from 8 to 9 A. M.

	Wednesday morning. Committees wishing to schedule only one meeting can be called together at either the Tuesday Evening Hour or the Wednesday Morning Hour at the pleasure of the Committee Chairmen.
8:00 P. M.	President's and Dean's Reception, Faculty Club, Adminstration Building.
	Wednesday, June 15
8 A. M.–12 NOON	General Registration and Room Registration, Pomerene Hall.
8 A. M.–9 A. M.	Sectional Commitee Meetings. Manufacturing Section Committees. Rooms as assigned for the previous evening. Production Section Committees. Rooms as assigned for the previous evening.
8 A. M.–9 A. M.	Inspection of Extension Exhibits, Horticulture & Forestry, 203, 204, 205, E. C. Scheidenhelm, Chairman.
9 A. M.–11:30 A. M.	Sectional Meetings. Production Section, Botany & Zoology Bldg., 100. Manufacturing Section, Campbell Hall Auditorium, 200. Extension Section, Horticulture & Forestry Bldg. 206.
11:30 A. M.–1 P. M.	Complimentary Dairy Luncheon. Animal Husbandry Bldg.
1 P. M.–4 P. M.	Sectional Meetings. Manufacturing Section, Campbell Hall Auditorium, 200. Production Section, Botany & Zoology Bldg., 100. Extension Section, Horticulture & Forestry Bldg. 206.
4 P. M.–5 P. M.	Sectional Business Meetings.
8 P. M.	Entertainment.
	Thursday, June 16
8 A. M.–9 A. M.	Committee Meetings. Production Section, Committee meeting rooms as previously scheduled. Manufacturing Section, Committee meeting rooms as previously scheduled.
9 A. M.–12 A. M.	Sectional Meetings. Extension, Horticulture & Forestry Bldg., 206. Production, Botany & Zoology Bldg., 100. Manufacturing, Campbell Hall Auditorium, 200.
3:30–4:30 P. M.	General Business Meeting, Campbell Hall Auditorium, 200.
6:30 P. M.	Annual Banquet. Presentation of Borden Awards.

Friday, June 17

Wooster, Ohio

10:30–12 NOON — General Session, Earl Weaver, Presiding.
Welcome, Edmund Secrest, Director, Ohio Agricultural Experiment Station.
Response, Earl Weaver, Vice President, American Dairy Science Association.
Papers:
(1) The Contribution of Production Research to the Advancement of the Dairy Industry. H. B. Ellenberger, Head, Dept. of Animal and Dairy Husbandry, University of Vermont.
(2) The Contribution of Manufacturing Research to the Advancement of the Dairy Industry. H. H. Sommer, Professor of Dairy Industry, University of Wisconsin.
(3) The Interrelationships of Production and Manufacturing Research in the Development of the Dairy Industry. Ernest L. Anthony, Dean of Agriculture, Michigan State College.

12 NOON–1 P. M. — Box Luncheon.

1 P. M. — Tours to Points of Interest at the Ohio Agricultural Experiment Station.

SECTION PROGRAMS

EXTENSION AND PRODUCTION JOINT MEETING

W. E. KRAUSS, *Chairman*

Tuesday P. M., June 14, 2:30–4:30

Campbell Hall Auditorium, 200

Symposium on Nutrition

P1—New facts in nutrition applied to dairy cattle. C. F. Huffman, Michigan State College.

P2—Vitamin E and reproduction in herbivora. B. H. Thomas, C. Y. Cannon, S. H. McNutt, and G. Underbjerg, Iowa State College.

P3—Relation of nutrition to the hormones. C. W. Turner, Missouri Agricultural Experiment Station.

P4—Rumination and paunch activity. (Moving pictures of the "darkest place in the world.") A. F. Schalk, Ohio State University.

MANUFACTURING SECTION

Tuesday P. M., June 14, 2:30–4:30

Dairy Laboratory, Townshend Hall

Dairy Products Judging Conference for Coaches and Instructors

Professors L. H. Burgwald and J. H. Erb in charge.

EXTENSION SECTION

E. N. SHULTZ, *Chairman*

Wednesday A. M., June 15, 9–11:30

Horticulture and Forestry Bldg., Room 206

Testing Committee Report. FLOYD JOHNSTON, *Chairman*

E1—Methods of presenting different extension practices in the testing project. Glen W. Vergeront, University of Wisconsin.

E2—Herd averages computed by the cow-year method versus herd averages based on cows on test at least 10 months. J. L. Lush and F. Johnston, Iowa State College.

FEEDING COMMITTEE REPORTS, K. L. TURK, *Chairman*

E3—An extension program coordinating dairying, crops, farm engineering, farm management and forestry. A. R. Merrill, Connecticut State College.

E4—A method used to illustrate the fact that higher producing cows make larger returns. W. T. Crandall, Cornell University.

E5—An extension program in grassland farming. C. B. Bender, New Jersey Agricultural Experiment Station.

E6—A method for preventing onion flavor in milk. C. E. Wylie, University of Tennessee.

PRODUCTION SECTION

Wednesday Morning, June 15, 9–11:30

Botany and Zoology Bldg., 100

H. W. CAVE, *Chairman*

Pasture, Hay and Silage

P5—Effect of fertilizer treatments on nutrients produced by pastures. R. A. Ackerman and H. O. Henderson, West Virginia Agricultural Experiment Station.

P6—A method of studying the deficiencies of alfalfa hay and the feeding value of various feeds as supplements to alfalfa hay. C. F. Huffman, Michigan State College.

P7—Air dried hay for dairy heifers. C. E. Wylie and S. A. Hinton, and J. W. Weaver, Jr., University of Tennessee and Tennessee Valley Authority.

P8—The influence of certain rations and management practices on the rate of growth of Holstein Friesian heifers. R. G. McCarty and A. C. Ragsdale, University of Missouri.

P9—The comparative nutritive value of sun cured pea vines, artificially dried pea vines and pea vine silage. J. C. Knott, R. E. Hodgson, and E. V. Ellington, State College of Washington and Bureau of Dairy Industry, U. S. D. A.

P10—Experience in ensiling partially cured alfalfa, methods used, losses sustained, and feeding value. J. B. Shepherd and T. E. Woodward, Bureau of Dairy Industry, U. S. D. A.

P11—Methods of making and feeding alfalfa molasses silage. B. R. Churchill and R. E. Horwood, Michigan State College.

P12—The influence of the quality of protein in the concentrate mixture on the production of dairy cows fed mixed hay and corn silage. G. W. Salisbury and F. B. Morrison, Cornell University.

P13—The influence of fineness of grinding on the coefficients of digestion on dairy cows. T. M. Olson and G. C. Wallis, South Dakota, State College.

MANUFACTURING SECTION

Wednesday Morning, 9–11:30

Campbell Hall, Room 200

C. J. BABCOCK, Presiding

Market Milk

M1—Some factors affecting the estimation of fat in milk by the Babcock method. W. A. Caldwell and E. O. Herreid, Vermont Agricultural Experiment Station.

M2—Cause and prevention of the decrease in fat test of composite samples. R. F. Holland, Cornell University.

M3—A study of the Resazurin test as applied to cream. Herbert Jenkins, New England Dairies, Inc., Boston, Mass.

M4—Studies of lipase action in milk. Vladimir N. Krukovsky and B. L. Herrington, Cornell University.

M5—Observations on the lipase activity in cows' milk. J. C. Pfeffer, H. C. Jackson, K. G. Weckel, University of Wisconsin.

M6—Detecting milk that may become oxidized. George R. Greenbank, Bureau of Dairy Industry, U. S. D. A.

M7—The relation of oxidation–reduction potential to oxidized flavor in milk. George R. Greenbank, Bureau of Dairy Industry, U. S. D. A.

M8—A study of the relation of titratable acidity to metal-developed oxidized flavor in milk. W. Carson Brown and R. B. Dustman, West Virginia Experiment Station.

M9—Studies on the activated flavor of milk. J. C. Flake, H. C. Jackson and K. G. Weckel, University of Wisconsin.

EXTENSION SECTION

Wednesday P. M., June 15, 1:00–4:00

Horticulture and Forestry Bldg., Room 206

J. F. KENDRICK, *Chairman*

Sire Committee Reports

E7—The use of electric fence in bull pen construction. J. W. Linn, Kansas State College. Discussion to be led by A. I. Mann, Connecticut Agriculture College.

E8—Dairy cattle breeding schools. E. E. Heizer, Ohio State University.

E9—Herd analysis and production pedigrees. S. J. Brownell, Cornell University.

J. C. NAGEOTTE, *Chairman*

Calf Club Committee Reports

E10—Four H dairy programs, requirements and recommendations. H. A. Willman, Cornell University.

E11—Relationship between the dairy extension section and the national Four H rules committee. M. L. Flack, University of Nebraska.

E12—Use of movies in dairy extension instruction. J. C. Nageotte, Pennsylvania State College.

C. J. BABCOCK, *Chairman*

Quality Committee Reports

E13—Report of Quality Committee Extension Section, American Dairy Science Association. C. J. Babcock, Chairman.

E14—Progress report of Quality Committee of Dairy Products of the Manufacturing Section of The American Dairy Science Association. W. H. E. Reid, Missouri Agricultural Experiment Station.

E15—Milk schools as a means of improving the milk supply. J. A. Nelson, Montana State College.

PRODUCTION SECTION

Wednesday P. M., June 15, 1:00–4:00

Botany and Zoology Bldg., Room 100

W. E. KRAUSS, *Chairman*

P14—The relation of certain succulent roughages to the color and flavor of milk. H. H. Tucker, O. F. Garrett, C. B. Bender. New Jersey Agricultural Experiment Station.

P15—The effect of the level of feeding dairy cows upon the flavor of their milk. J. C. Hening and A. C. Dahlberg, New York Agricultural Experiment Station.

P16—A study of some of the physico-chemical effects of soybeans on the fat in cow's milk. R. W. Bratton, W. F. Epple, J. W. Wilbur, and J. H. Hilton, Purdue University.

P17—The vitamin D. content of the milk produced by Jersey and Holstein cattle receiving the same vitamin D. intake. G. C. Wallis, South Dakota State College.

P18—Plasma magnesium studies on the growing bovine. C. W. Duncan and C. F. Huffman, Michigan State College.

P19—The normal concentration of inorganic phosphorus in the blood of lactating dairy cows and factors affecting it. A. H. VanLandingham, H. O. Henderson, and G. A. Bowling, West Virgina Agricultural Experiment Station.

P20—The carotene content of market hays and corn silage as determined by a quantitative adsorption procedure. L. A. Shinn, H. G. Wiseman, E. A. Kane, and C. A. Cary, Bureau of Dairy Industry, U. S. D. A.

P21—Relationship between carotene, blindness due to constriction of the optic nerve, papillary edema and night blindness in calves. L. A. Moore, Michigan Agricultural Experiment Station.

P22—The carotene requirements for normal reproduction. H. T. Converse and E. B. Meigs, Bureau of Dairy Industry, U. S. D. A.

P23—Vitamin A for growth and reproduction in dairy heifers. I. R. Jones and J. R. Haag, Oregon State College.

P24—Value of dried molasses and yeast for dairy calves. O. L. Lepard, P. E. Newman, and E. S. Savage, Cornell University.

MANUFACTURING SECTION

Wednesday P. M., June 15, 1:00–4:00

Campbell Hall, Room 200

C. J. BABCOCK, Presiding

Butter and Swiss Cheese

M10—Variation in the compostion of milk and the effect on solids-not-fat. H. A. Herman, University of Missouri. *(Market Milk Con't)*

M11—Studies on mold mycelia content of sour cream butter. J. Adams and E. H. Parfitt, Purdue University.

M12—The effect of temperature upon score value and physical structure of butter. W. H. E. Reid and W. S. Arbuckle, University of Missouri.

M13—Application of the Burri smear culture technic to the examination of butter. H. F. Long and B. W. Hammer, Iowa Agricultural Experiment Station.

M14—The application of the phosphatase test to the butter industry. W. H. Brown and E. H. Parfitt, Purdue University.

M15—Preliminary studies of the neutralization of cream for buttermaking. R. C. Townley and I. A. Gould, Michigan State College.

M16—The relation of milk quality to grade of Swiss cheese. L. A. Rogers, Robert E. Hardell and Fred Feutz, Bureau of Dairy Industry, U. S. D. A., in cooperation with the Ohio State University and the University of Wisconsin.

M17—Clarification of milk for the manufacture of Swiss cheese, with special reference to the use of mastitis milk. Kenneth J. Matheson, George P. Sanders, Lloyd A. Burkey, and J. Frank Cone, Bureau of Dairy Industry, U. S. D. A.

M18—Control of types of organisms in high temperature starters. Dave Nusbaum and Walter V. Price, University of Wisconsin.

M19—Methods of determining chlorine in milk and their application in the detection of mastitis. George P. Sanders, Bureau of Dairy Industry, U. S. D. A.

M20—Controlling the fact content of Swiss cheese in southern Wisconsin. Walter V. Price, University of Wisconsin.

EXTENSION SECTION

Thursday morning, June 16, 9:00–12:00

Horticulture and Forestry Bldg., Room 206

Sire Committee Reports, J. F. KENDRICK, *Chairman*

Artificial Insemination

E16—Technique—Discussion by
S. J. Brownell, Cornell University and
E. J. Perry, New Jersey College of Agriculture

E17—Use of artificial insemination in Farm Security Veterinary Associations. J. R. Allgyer, Farm Security Administration, U. S. D. A.

E18—What we can learn from Denmark in the organized use of artificial insemination. E. J. Perry, New Jersey College of Agriculture.

PRODUCTION SECTION

Thursday morning, June 16, 9:00–12:00

Botany and Zoology Bldg., Room 100

L. A. MAYNARD, *Chairman*

Milk Secretion, Metabolism, and Udder Disease

P25—Initiation of lactation in the albino rat. R. P. Reece, New Jersey Agricultural Experiment Station.

P26—Recent advances in our knowledge on the endocrine control of mammary development. E. T. Gomez and C. W. Turner, Missouri Agricultural Experiment Station.

P27—The biological assay of "mammogen". A. A. Lewis and C. W. Turner, Missouri Agricultural Experiment Station.

P28—Milk and fat production of dairy cows as influenced by thyroxine and anterior pituitary extracts. N. P. Ralston and H. A. Herman, Missouri Agricultural Experiment Station.

P29—Vitamin C metabolism in the dairy cow. W. H. Riddell and C. H. Whitnah, Kansas Agricultural Experiment Station.

P30—Fat metabolism of the mammary gland. J. C. Shaw and W. E. Petersen, University of Minnesota.

P31—An enzymatic relationship to the synthesis of milk fat. Philip L. Kelly, University of Arkansas.

P32—The effect of fasting and refeeding on milk secretion in the cow and goat. L. E. Washburn, University of Missouri.

P33—The course of fasting energy production curves in the lactating and dry dairy cow under similar environmental conditions. L. E. Washburn, University of Missouri.

P34—Nature of swelling in the cow's udder at calving time. W. W. Swett, C. A. Matthews, and R. R. Graves, Bureau of Dairy Industry, U. S. D. A.

MANUFACTURING SECTION

Thursday morning, June 16, 9:00–12:00

Campbell Hall, Room 200

C. J. BABCOCK, Presiding

By-products and Ice Cream

M21—Sodium per borate as a corrosion inhibitor for washing powders. Lawrence L. Little, Meadow Gold Milk Plant, Oklahoma City.

M22—Sterilization by irradiation—a possible new tool for the dairy industry. O. F. Garrett and R. B. Arnold, New Jersey Agricultural Experiment Station.

M23—Kefir Buttermilk. Lloyd A. Burkey, Bureau of Dairy Industry, U. S. D. A.

M24—The present status of the development of fiber from casein. Earle O. Whittier, Bureau of Dairy Industry, U.S.D.A.

M25—Whey solids in candy. Byron H. Webb, Bureau of Dairy Industry, U. S. D. A.

M26—Effect of the cold storage temperature, pasteurization treatment, and homogenization pressure on the properties of frozen condensed milk. Raymond W. Bell, Bureau of Dairy Industry, U. S. D. A.

M27—Consumer preference as related to the analysis of vanilla ice cream in Tennessee. Thos. B. Harrison, H. B. Henderson, and C. E. Wylie, University of Tennessee.

M28—The use of moving pictures in ice cream investigations. W. H. E. Reid, W. S. Arbuckle and R. J. Drew, Missouri Agricultural Experiment Station.

M29—Application of the phosphatase test to determine the efficiency of pasteurization of ice cream mix. A. J. Hahn and P. H. Tracy, University of Illinois.

M30—Influence of certain mix components upon the rate at which freezing occurs in ice cream as measured by the dilatometer method. W. C. Cole and J. H. Boulware, University of California.

PRODUCTION SECTION

Thursday P.M., June 16, 1:00–3:30

Botany and Zoology Bldg., Room 100

J. B. Fitch, *Chairman*

P35—Some factors affecting the resistance of animals to mastitis. L. A. Burkey, E. B. Meigs, G. P. Sanders, and M. Rogosa, Bureau of Dairy Industry, U. S. D. A.

P36—Preventing sudan grass poisoning. Frederick Boyd, O. S. Aamodt, G. Bohstedt and E. Truog, University of Wisconsin.

P37—A report of the occurrence of four cases of Agnathia. Fordyce Ely, H. B. Morrison, and F. E. Hull, Kentucky Agricultural Experiment Station.

P38—Maximum initial yield and persistency as inherited characters influencing total lactation yield. L. O. Gilmore, W. E. Petersen, and J. B. Fitch, University of Minnesota.

P39—Herd averages computed by the cow-year method versus herd averages based only on cows on test at least 10 months. J. L. Lush and F. Johnston, Iowa State College.

P40—Age and its influence on culling and life expectancy in dairy cows. D. M. Seath, Kansas State College, and J. L. Lush, Iowa State College.

P41—The breeding efficiency of proved (aged) sires. J. R. Dawson, Bureau of Dairy Industry, U. S. D. A.

P42—Twelve years with 1200 Holsteins. J. D. Brag, Ohio Department of Public Welfare.

P43—Artificial insemination of dairy cattle. C. L. Cole, University of Minnesota.

P44—Relation between rate of growth and milk and fat production. H. P. Davis and E. L. Willett, University of Nebraska.

MANUFACTURING SECTION

Thursday P.M., June 16, 1:00–3:30

Campbell Hall, Room 200

C. J. Babcock, Presiding

Cheese and Soft-Curd Milk

M31—A study of quality variations in summer and winter made cheeses. J. C. Marquardt, New York Agricultural Experiment Station.

M32—Starters used in Wisconsin brick cheese factories. Willard L. Langhus, Paul R. Elliker, University of Wisconsin.

M33—Methods which help to retain fat in American cheddar cheese at high temperatures. Harry L. Wilson, Bureau of Dairy Industry, U. S. D. A.

M34—X-ray diffraction analysis of white specks in cheddar cheese. S. L. Tuckey, H. A. Ruehe and G. L. Clark, University of Illinois.

M35—Studies on the ripening of blue cheese. C. B. Lane and B. W. Hammer, Iowa Agricultural Experiment Station.

M36—Studies on the vitamin A content of cheese. I. L. Hathaway and H. P. Davis, University of Nebraska.

M37—Plant experience with sonic soft curd milk. Leslie A. Chambers, Eldridge Reeves Johnson Foundation and University of Pennsylvania.

M38—The digestibility of natural and processed soft curd milks. C. C. Flora and F. J. Doan, Pennsylvania State College.

M39—The relationship between curd tension and curd size. Leslie A. Chambers and Irving J. Wolman, Eldridge Reeves Johnson Foundation and University of Pennsylvania.

M40—Artificial gastric digestion of milk. Maurice E. Hull, M. & R. Dietetic Laboratories, Inc., Columbus, Ohio.

PAPERS READ BY TITLE

Production

1. The relation of milking machines to the incidence of mastitis. Edward B. Meigs, Henry T. Converse, Division of Nutrition and Physiology, and Lloyd A. Burkey, Morrison Rogosa, and George P. Sanders, Bureau of Dairy Industry, U. S. Department of Agriculture.
2. Sudan grass hay vs. clover hay for dairy cows. C. E. Wylie and S. A. Hinton, University of Tennessee.
3. The extraction and assay of the hormones of cattle and sheep pituitaries. A. J. Bergman and C. W. Turner, University of Missouri.
4. Relation of lactic acid and glucose of the blood and glycogen in the mammary gland to milk secretion. W. E. Petersen, J. C. Shaw, University of Minnesota.
5. The carotene requirement of dairy calves. Ruel E. Ward, S. I. Bechdel, and N. B. Guerrant, Pennsylvania State College.

Manufacturing

6. Revised United States standards for quality of creamery butter. Roy C. Potts, United States Bureau of Agricultural Economics.
7. Effect of temperature and composition upon the physical properties and dipping qualities of ice cream. W. H. E. Reid, R. J. Drew and W. S. Arbuckle, University of Missouri.
8. A comparative study of metal and glass petri dish covers. Herbert Jenkins, New England Dairies.
9. Summary of experiment with the DeLaval standardizer. J. H. Frandsen, Massachusetts State College.
10. Methylene blue reduction time as an indication of the suitability of milk for the manufacturing of Swiss cheese. A. B. Erekson, C. A. Eckburg and E. Lee, The Borden Company.
11. Casein milk fat as a foam depressant in casein-clay slips. G. A. Richardson and N. P. Tarassuk, College of Agriculture, Davis, California.
12. The relationship of mastitis milk and soft-curd milk to the manufacture of Swiss cheese. Kenneth J. Matheson, Lloyd A. Burkey, George P. Sanders, and Robert R. Farrar, Bureau of Dairy Industry, U. S. D. A.

Extension

13. Texas one day shows. G. G. Gibson and E. R. Eudaly, Texas A. & M. College.
14. The Texas trench silo program E. R. Eudaly and G. G. Gibson, Texas A. & M. College.

PROGRAM FOR LADIES' AND YOUNG PEOPLES' ENTERTAINMENT

THIRTY-THIRD ANNUAL MEETING

THE AMERICAN DAIRY SCIENCE ASSOCIATION

THE OHIO STATE UNIVERSITY
COLUMBUS, OHIO
JUNE 14–15–16, 1938

AND

OHIO AGRICULTURAL EXPERIMENT STATION
WOOSTER, OHIO

JUNE 17, 1938

PROGRAM FOR LADIES' AND YOUNG PEOPLES' ENTERTAINMENT, AMERICAN DAIRY SCIENCE ASSOCIATION

COLUMBUS, OHIO, JUNE 14, 15, 16, 1938

The following program has been arranged for the pleasure of the ladies and young people attending the convention. No program has been arranged for the ladies during the day on Tuesday, believing they would appreciate the time for rest and visiting. Headquarters will be in Pomerene Hall, women's recreational building at Ohio State University, located on the east side of Neil Avenue, adjacent to and south of Mirror Lake. The lounges will be available for use at all times. This will be a delightful place to meet your friends.

The young people's program starts at 1:30 P. M. Tuesday. Capable counsellors will supervise the activities of the various age groups. The Nursery School quarters in Campbell Hall, across Neil Avenue from Pomerene Hall, will be available for the care of pre-school children during the day. Experienced persons will be in charge.

Girls who have had experience in caring for children in the evening will be available for this service at a rate of 30 cents per hour with a maximum charge of $1.00 per evening. Notice of such need should be filed with the registration clerks.

Pomerene Refectory, a delightful dining hall, will be open for meals each day. This is located on the first floor of Pomerene Hall. Service will be from 7:00 A. M. to 9:30 A. M., breakfast; lunch from 11:00 A. M. to 1:30 P. M.; evening from 5:00 P. M. to 7:30 P. M.

Mail will be received at the registration booth in Pomerene Hall and should be addressed in care of American Dairy Science Association, Pomerene Hall, Ohio State University, Columbus, Ohio.

PROGRAM

Subject to change dependent on weather and other unforseen conditions. In such a case suitable announcements will be made and notices posted at registration booth.

Tuesday, June 14, 1938

1:30 P. M. The young people will meet at Pomerene Hall, Neil Avenue, Campus, for a tour of the University Campus.
Ladies will have the afternoon free. Pomerene Hall lounges will be available.

7:30 P. M. Young people's party, Neil Hall, located one block south of University on the east side of Neil Avenue.

8:00 P. M. President's & Dean's Reception, Faculty Club, Administration Building.

Wednesday, June 15, 1938

9:00 A. M. Pre-school children will be cared for at Campbell Hall, located across Neil Avenue from Pomerene Hall.

9:30 A. M. Ladies will leave Pomerene Hall for a tour of the University flower gardens and green houses.

Young people will meet at Pomerene Hall for outdoor games and contests arranged for young folk of all ages.

10:00 A. M. Ladies will see Mr. G. H. Poesch, floriculturist, give a demonstration on flower arrangement.

11:00 A. M. Ladies will visit the Ohio Archaeological and Historical Museum on the campus and will hear Mr. H. C. Shetrone, Director, discuss interesting facts regarding Ohio.

NOON Lunch will be served at Pomerene Refectory in Pomerene Hall. The young people will have a private dining room where a desirable lunch will be served for 25 cents.

1:30 P. M. Motion pictures for the young folk at University Hall Auditorium.

2:00 P. M. Ladies will visit The Columbus Gallery of Fine Arts on East Broad Street. Mr. Philip R. Adams, director of the Art Gallery will conduct the tour. Transportation will be provided starting from Pomerene Hall promptly.

3:00 P. M. Swimming parties for the young folk. Arrangements will be made for the use of swimming pools on the campus. Competent persons will be in charge.

4:30 P. M. Tea for the ladies in the Lounge, Pomerene Hall.

8:00 P. M. Entertainment for all attending the convention. University Hall Auditorium and Natatorium. This will be an evening of fun and relaxation.

Thursday, June 16, 1938

9:30 A. M. Pre-school children will be cared for at Campbell Hall. Young people will meet at Pomerene Hall for a visit to the Ohio Archaeological and Historical Museum, University Campus.

10:00 A. M. Ladies will leave Pomerene Hall for a tour of the M. & R. Dietetic Laboratories and the Moores and Ross Milk Plant. The Dietetic Laboratories are famous for their baby food and other nutritional products while Moores and Ross are known to have one of the finest milk and ice cream plants. Transportation will be provided for the day.

NOON The young people will lunch together at Pomerene Hall Refectory. Lunch will cost 25 cents.

1:00 P. M. Ladies will have a complimentary luncheon at the Columbus Country Club which is located on East Broad Street. This is one of the beauty spots of our city.

1:30 P. M. The young people will leave Pomerene Hall for a trip to the Columbus Zoo followed by a picnic in Riverside Park. They will return to the campus about 8:00 P. M.

6:30 P. M. Banquet at Neil House located between Broad and State Streets on High Street, across the street from the State Capitol.

ABSTRACTS OF PAPERS PRESENTED AT ANNUAL MEETING

GENERAL SESSION

2. **Measuring the Results of Instruction in the Dairy Sciences.** R. W. TYLER, Bureau of Educational Research, Ohio State University.

Measuring the results of Dairy Science instruction is important not merely as a basis for assigning grades but to identify the difficulties students are having and to determine the effectiveness of particular courses, materials and methods of teaching. In order that measurement may serve these purposes more effectively it is necessary to develop better tests and examinations. Present examinations provide evidence regarding the information students are acquiring but the tests do not indicate how far students are achieving other important objectives such as the ability to apply facts and principles, the ability to observe accurately, scientific attitude, personality, characteristics and the like. To develop a more adequate measurement program it is necessary to formulate all of the important objectives of dairy science courses clearly in order to see just what things must be measured. After these objectives have been formulated and defined it is then necessary to devise means of testing for each of these important objectives. Experimentation in other science fields has shown the possibility of developing tests for many of these so-called "intangible" objectives of education and the use of these tests has made it possible to improve teaching at many points. Samples of such tests will be described in the paper and illustrations given about their uses.

3. **Summer Practicum in Dairy Husbandry.** A. A. BORLAND, Pennsylvania State College.

The commercial dairy world frequently asserts that college graduates have insufficient practical experience to justify their being placed in positions of even moderate responsibility. Undoubtedly this criticism has been made because in certain instances the facts have warranted the complaint. We all recognize that Colleges and Universities do not recommend their graduates in dairying as finished products, but do try to give their graduates a good fundametal education in chemistry, physics, mathematics, bacteriology and economics, with some training in dairying, so that with the later acquisition of experience they may become leaders in the dairy industry. Nevertheless, when a college graduate because of his lack of experience makes a poor showing in practical dairy work immediately after leaving college, considerable criticism of the institution from which he graduated is occasioned. It is to obviate this situation to as great an extent as possible that summer practicum work has been devised.

This subject, known at The Pennsylvania State College as D.H. 17, Summer Practicum, is required of all four-year students in Dairy Hus-

bandry. The subject carries 6 credits and calls for at least 6 weeks' practical work of not less than 48 hours a week in an approved dairy plant or on an approved dairy farm, depending upon whether the student is majoring in Dairy Manufacturing or Dairy Production.

The subject carries honor points if it is conducted under the immediate supervision of the instructor in the College Creamery or the College Dairy Barn in which case the student receives no financial remuneration. If taken at a farm or plant away from the college, the student may receive as much remuneration as his services warrant. In this case he gets credit for the subject provided his work has been satisfactory and he has turned in a creditable write-up of his summer's work, but receives no honor points.

The subject is taken during the vacation period following the junior year. Before June 1st the student must submit duplicate outlines concerning the information he expects to secure on the farm or in the plant during the summer. The instructor may make suggestions for the improvement of the outlines, then retains one for himself and returns the other to the student for his guidance. During the summer the student in addition to his practical work gathers data for writing up the dairy farm or plant during the first semester of his senior year. This write-up must be turned in during the first semester. The student is graded according to the merit of his paper and the report on his work by his employer.

This system insures that every student graduating from college has had at least six weeks of practical dairy plant or dairy farm work in addition to that which he received in college. The student when he graduates has more confidence in his own ability to do creditable work than when he has had no commercial experience. Frequently his summer work leads to permanent employment since students who have made good in their summer practicum work are in many cases offered positions by firms that would not otherwise employ additional help. Finally, students with some commercial experience are in so much better shape to do satisfactory practical work that a much higher percentage of them succeed in their chosen field of work than would otherwise be the case.

4. A Service Course in Dairying for Home Economics Students. K. M. RENNER, Texas Technological College.

A discussion of the content material for a course in dairying to be given to students in Home Economics. An outline of such a course, which has been given at the Texas Technological College for the past eight years, will be presented. The desirability of such a course has been well established and the results secured have been very satisfactory. The course is elected primarily by students fitting themselves to do County Home Demonstration work and by those preparing for teaching in rural communities. The course includes a rather wide variety of subject matter and the field of dairying with

which the type of student mentioned naturally comes in contact in his or her field work. Practical laboratory work is given the students, enabling them to become more familiar with the methods of carrying on dairy demonstration work with rural people. Three credit hours are allowed each student.

PRODUCTION SECTION

P1. New Facts in Nutrition Applied to Dairy Cattle. C. F. HUFFMAN, Michigan State College.

As the spread between the price of feed and butterfat narrows, the interest in more economical production of butterfat increases. This means a greater use of home grown feeds, especially roughage.

Greater use of pasture for dairy cows is receiving considerable attention. The classical work of several experiment stations during the past few years has demonstrated the high nutritive effects of grasses and legumes when used before lignification interferes with digestibility. The discovery of so-called "grass factor or factors" in milk produced during the summer has also enhanced interest in pasture. The importance of using fertilizers on pastures to improve yield of nutrients has been investigated.

The conservation of roughage for winter use is one of the most important problems in dairy cattle nutrition. Artificial drying of roughages yields a good product but the cost appears prohibitive.

Several experiment stations, here and abroad, have studied grass and legume silage. The use of mineral acids in sufficient amounts to reduce the pH of the silage mass below four, preserves the nutrients especially carotene, but the cost appears high for general use.

The use of molasses in making legume silage is enjoying considerable popularity. Recent work indicates that legumes are low in fermentable carbohydrates. The molasses furnishes additional fermentable carbohydrates for the production of lactic and acetic acids. There is a diversity of opinion regarding the value of molasses for this purpose, however. Some recent investigations indicate that good legume silage can be made without any additions, and that the exclusion of air is the main factor to be considered.

Some workers in the field of energy relations have concluded that the productive or net energy value of a feed depends on the balance of nutrients in that feed. The nutritive properties of individual feeds are not always additive when they are combined in the ration, because of the associative effects of feeds in digestion and their supplementing effects in metabolism. A well balanced ration should exert an energy value about in proportion to its total digestible nutrients.

Several workers have reported results with alfalfa hay as the sole ration, which indicates efficient use of total digestible nutrients. Other investigators have reported poor utilization of the total digestible nutrients on a ration of

alfalfa hay alone, which indicates a wide variation in the feeding value of alfalfa hay.

The essential amino acids necessary in the ration of milking cows remains unsolved. The evidence is increasing that cattle are able to use nitrogen in the form of urea and ammonium salts in place of protein. Rumen flora are believed to play a rôle in this phenomenon.

Cobalt has been added to the list of essential minerals. Recent work in various parts of the world indicates that a deficiency of this element occurs among cattle, which results in anemia. Nickel and copper appear to aid in cobalt utilization.

Iron, potassium and magnesium are required by cattle but there is no evidence that a deficiency of these minerals occurs under field conditions.

Fluorine, selenium and molybdenum at fairly low levels in the ration are detrimental to health. Pasture grasses high in manganese may disturb magnesium metabolism.

Recent work indicates that the addition of yeast to the ration of calves receiving a limited amount of whole milk improved growth. The vitamin G in the yeast was believed to be responsible for this observation.

The advisability of feeding cod liver oil to dairy calves under farm conditions has been further investigated. The results are not definite.

Recent investigations have failed to show that vitamin E is required by ruminants. The possible relation of vitamin K to sweet clover poisoning in cattle is of interest.

The relation of feed of the cow to flavor and to the nutritive value of milk has also received considerable attention during the past year.

The three "mystery diseases," namely: milk fever, grass tetany and ketosis, have also been studied from the standpoint of nutrition.

P2. Vitamin E and Reproduction in Herbivora. B. H. Thomas, C. Y. Cannon, S. H. McNutt and G. Underbjerg, Iowa State College.

Numerous scientific data reveal that qualitative inadequacies of the diet can evoke reproductive disorders in animals. Among the vitamins the one invariably thought of in this connection is vitamin E. The deleterious effect of avitaminosis E on fertility in rats and mice and on decreased hatchability of eggs has been demonstrated. Vitamin E has been recommended recently as an adjuvant to practical rations for improving the fertility and fecundity of farm animals. Whether or not avitaminosis E will interfere with the normal development of the fetuses of herbivora as in female rats has not been demonstrated heretofore.

To determine the importance of vitamin E to reproduction among farm animals we restricted goats, sheep and rabbits during one or more generations to a vitamin E-deficient ration. Essentially the same basal feed mixture of ground grains and their by-products and finely chopped alfalfa was fed to all

animals. The vitamin E occurring naturally in this mixture was destroyed or inactivated by treating it with an ether solution of ferric chloride and subsequently aging each treated batch of feed until it acquired a decidedly rancid odor. All animals received the basal ration, water and iodized salt, *ad libitum*. The treated basal ration was fortified at feeding time with a vitamin E-free supplement compounded primarily to protect against other possible avitaminoses.

Our study of this problem has demonstrated that the dietary vitamin E requirements of different species of animals may differ markedly. For example: weaning male rats restricted to the ferric chloride treated ration exhibited initial stages of testicular degeneration in two months and became permanently sterile in eight months or less. Female rats reared similarly repeatedly resorbed their young.

Unlike rats, the reproductive behavior of male and female goats apparently was unaffected during a period of four and one-half years, although restricted at all times to the same ferric chloride treated ration. Thus, our original flock of seven goats was expanded to forty-eight without exhibiting reproductive disorders attributable to avitaminosis E. Similarly, twelve original male and female rabbits kindled 137 fully developed young in two years, however not without an occasional reproductive disorder, the cause of which we have not yet ascertained. Whether or not the vitamin E requirements of sheep compare with those of rats or goats is impossible to state definitely at present. Our studies with sheep and rabbits are being expanded.

There is a dearth of scientific data evaluating the vitamin E requirements of farm animals. Yet statements have been made inferring that vitamin E therapy will markedly decrease reproductive disorders prevalent in herds, flocks and studs. Investigations have shown that vitamin E is present in most of the ingredients commonly used in compounding livestock and poultry rations. To be sure, there is no knowledge of the changes in vitamin E activity which may occur in milled feeds through processing or aging. However, it is evident that the vitamin E requirements of certain species of animals differ markedly from those of others. Obviously stockmen should be cautioned against relying on vitamin E therapy as a panacea for decreased fertility and fecundity until additional information is obtained.

P3. Relation of Nutrition to the Hormones. C. W. TURNER, Missouri Agricultural Experiment Station.*

The relation of nutrition to the hormones which influence body growth, reproductive processes, and milk secretion is largely unexplored. The effect of improper amount or balance of the nutritive constituents of the ration has usually been interpreted as due to the absence of or deficiency in the essential

* Contribution from the Department of Dairy Husbandry, Missouri Agr. Exp. Sta., Journal Series No. 552.

components (amino acids, energy, minerals, and vitamins) for the growth of the body or the synthesis of milk. Only recently has the rôle of nutrition in relation to the secretion of the various hormones affecting these processes begun to be appreciated.

Clearly, a deficiency of essential amino acids in the ration will influence the rate of growth or milk secretion. However, if the ration is deficient in constituents, either organic or inorganic, which influence the rate of secretion of one or more hormones concerned in the process of growth or milk secretion even though the ration were adequate in respect to the precursors of growth or milk, growth and milk secretion would be limited.

The need of certain trace elements in nutrition may be due to their presence in certain hormones. Thus the requirement of iodine is probably in very large part due to the need of the thyroid gland in the synthesis of thyroxine. As knowledge of the chemical composition of the hormones of the pituitary and other endocrine glands develops, the requirement of trace elements or other endocrine glands develops, the requirement of trace elements or other essential groupings will be recognized.

The interrelation of the vitamins and the hormones will undoubtedly develop as this field develops. Already numerous studies have shown a dependence of the pituitary in the secretion of the gonadotropic hormone upon vitamin B. Without this vitamin, estrus cycles soon cease and reproduction is held in abeyance until this vitamin is added to the ration. The quality of protein appears to influence the secretion of the gonadotropic hormone and practical observations with cattle on deficient rations (quantity as well as quality) show delayed estrum until rations improve. One symptom of phosphorus deficiency is a prolonged dietary anestrus which is probably traceable to a deficiency in rate of secretion of the gonadotropic hormone.

P5. Effect of Fertilizer Treatments on Nutrients Produced by Pastures. R. A. ACKERMAN AND H. O. HENDERSON, West Virginia Agricultural Experiment Station.

Eight plots totalling 39 acres were seeded to blue grass, red top, and white clover in 1931. Three different fertilizer treatments with check, in which no fertilizer or lime was added, were duplicated. The fertilizer treatments at the time of seeding and later follow:

Check Plots	No lime or fertilizer applied.
P–L Plots	Limed to pH 6.5 in 1931. 500# 20% superphosphate in 1931, and in 1933.
P–K–L Plots	P–L as above. 100# Muriate of potash in 1931 and in 1933.
N–P–K–L Plots	P–K–L as above. 200# Nitrate of soda per year except 1937, when only 100# was applied.

Pure bred Ayrshire heifers balanced as nearly as practicable into equal age and weight groups and receiving no supplemental nutrients have been grazed on these plots. By varying the number of heifers on a plot, all pastures have been grazed as uniformly as possible. Weights were taken on two consecutive days at the time the heifers were put on the pastures, at the time of their removal, and at intervals throughout the season.

The number of pasture days and gain in weight per acre, together with the average daily gain, was kept for the heifers on each plot. From this data the total digestible nutrients was calculated by using the figures given in the Morrison Feeding Standard. Over the five year period the complete fertilizer treatment more than doubled the number of pasture days and the number of pounds of total digestible nutrients produced on an acre, and the other treatments also showed a great increase in yield.

This is a partial progress report of five years (1933–37 incl.) results in a long time extensive pasture experiment conducted by the Department of Agronomy and Genetics, Department of Dairy Husbandry, and the Reymann Memorial Farms, of the West Virginia University.

P6. A Method of Studying the Deficiencies of Alfalfa Hay and the Feeding Value of Various Feeds as Supplements to Alfalfa Hay. C. F. HUFFMAN, Michigan State College.

The trend toward a greater use of home grown rations has prompted workers at several experiment stations to study the feeding value of alfalfa alone for milking cows. Experiments at Kansas and Oregon Stations showed that alfalfa alone did not yield as much milk energy as the total digestible nutrients in the alfalfa indicated. These results were in agreement with the energy value attributed to alfalfa hay by Fraps, Armsby and European workers. Graves and associates and workers at the Nevada Agricultural Experiment Station, however, have reported efficient utilization of the total digestible nutrients of alfalfa hay when fed alone.

In a long time alfalfa feeding experiment at the Michigan Agricultural Experiment Station cows receiving alfalfa supplemented with either corn, oats, barley or a complex grain mixture failed to maintain milk production and body weights during medium and low production, when they were getting most of their nutrients from alfalfa hay. The total digestible nutrients of the alfalfa exerted a low feeding value.

In reversal experiments either of short time nature or lactation reversals, the question of residual or carry over effect appears important. With our technique cows are placed on alfalfa alone at calving and left on this ration until the stored factors necessary to balance the alfalfa for milk production are exhausted. This is indicated by a sharp decline in milk flow. When milk produced had dropped to between 20–30 pounds daily a portion of the total digestible nutrients in alfalfa is replaced by an equal amount of total digestible nutrients in the feed to be tested.

The addition of soybean oil and corn oil to alfalfa alone did not affect milk production materially. Further evidence that fat was not the first deficiency of alfalfa alone was an increased milk yield when beet pulp or solvent soybean oil meal replaced a part of the alfalfa hay.

The addition of either corn, cottonseed meal or corn gluten meal in place of alfalfa has resulted in increased milk production.

This method appears to offer an effective, inexpensive method of studying the relative milk producing value of various supplements to alfalfa hay alone.

P7. Air Dried Hay for Dairy Heifers. C. E. Wylie and S. A. Hinton, University of Tennessee, and J. W. Weaver, Jr., Tennessee Valley Authority.

Hay Drying

To "make hay while the sun shines" has never been very successful in "rainy seasons." Artificial drying may produce splendid hay, but large dehydration plants costing $3,500 and up are of little use to the farmer who grows from 20 to 60 tons of hay a year.

The usual procedure in making hay, for one day, is to cut the hay in the morning, windrow it about midday, and put it in the barn in the afternoon if the weather has been favorable for curing. The principle of the special barn curing system as described in this report is to let the sun and wind of the open field do about 75 per cent of the curing the first day, and finish up the other 25 per cent after the hay is safely stored in the barn.

When the hay is 75 per cent cured it still has 35 to 45 per cent moisture —twice as much as is safe for storage, but just right for handling because the leaves are limp and there is very little loss from shattering. This damp hay is stored in the loft. The loft is equipped with a system of air ducts through which air from a blower is forced upward through the hay or drawn down through the hay, as desired. This process gradually removed the excess moisture and keeps the hay at about the wet-bulb temperature. By blowing air through the hay during the day only, and allowing the excess moisture in the hay to move to the surface of stems and leaves over night, curing is completed practically as soon as by continuous blowing. The use of a solar heat absorber to heat the air blown through the hay holds considerable promise as an economical means of speeding up the curing process with the same size blower.

Equipment for fitting up a hay loft of 20 to 30 tons capacity for their system can be bought and installed for about $300.00, or less than 10 per cent of the cheapest dehydrator now available.

Feeding Trials

During the winter of 1937–38 two groups of dairy heifers have been fed the hay which has been field cured and that which has been air cured.

Analyses have been made of the hay. An experiment is being run with rats to determine the vitamin A content. The growth of the heifers in each group was determined by weight, height, and girth measurements. At the completion of this trial the data indicate no significant difference in the feeding value of the hay cured by these two methods when fed to dairy heifers. Any difference, therefore, in these two methods of curing hay would seem to be in the amount and quality of the hay harvested from the field, including hay which has been damaged by rain.

P8. The Influence of Certain Rations and Management Practices on the Rate of Growth of Holstein Friesian Heifers. R. G. McCarty and A. C. Ragsdale, University of Missouri.*

The length of time and the amount of food nutrients required to grow dairy heifers to proper size and maturity for breeding are factors of considerable economic importance to dairy farmers. Obviously, any shortening of the growth period and consequent reduction in the unproductive life of the heifer may tend to reduce the cost of raising and will result in milk production and financial returns at an earlier age. This paper presents the results of an investigation on the influence of three rations on the rate of growth of Holstein heifers. The rations used were (1) milk and alfalfa hay supplemented only with common salt, (2) a basal ration herein also referred to as a "Rapid Growth" ration, and (3) the "Rapid Growth" ration modified to include 10 per cent of dehydrated cereal grasses.

Growth in all groups was measured by gain in live weight and height at withers and compared with "normal" as presented by Ragsdale in Mo. Agricultural Experiment Station Bulletin 336.

The heifers in Group 1 averaged 17.3 per cent *below* normal in weight and 4.1 per cent *below* normal in height at withers at six months of age. At 12 months the corresponding percentages below normal were 22.1 per cent and 5.0 per cent; at 18 months 11.8 per cent and 3.27 per cent; and at 24 months 13.8 per cent and 3.8 per cent, respectively.

The heifers in Group 2 averaged 23.2 per cent *above* normal in weight and 6.6 per cent above normal in height at withers when 6 months of age. At 12 months the corresponding percentages above normal were 32.6 per cent and 4.8 per cent; and at 18 months, 33.8 per cent and 5.9 per cent, respectively.

The corresponding data for the heifers in Group 3 in terms of percentages *above* normal were 20.3 per cent in weight and 5.8 per cent in height at withers; at 12 months 26.9 per cent and 4.7 per cent and at 15 months 27.5 per cent and 4.4 per cent, respectively. The heifers in all groups are being continued and data for later ages will be reported together with feed nutri-

* Contribution from the Dairy Husbandry Department, Missouri Agr. Exp. Sta., Journal Series No. 560.

ents required for gains and certain other observations when the investigation is complete.

P9. The Comparative Nutritive Value of Sun Cured Pea Vines, Artificially Dried Pea Vines and Pea Vine Silage. J. C. KNOTT, R. E. HODGSON AND E. V. ELLINGTON, State College of Washington and Bureau Dairy Industry, U. S. D. A.

Pea vines remaining after the peas had been removed for canning were preserved for feeding purposes by field curing, artificially drying and by making them into silage. Digestion experiments were conducted with wether sheep to determine the nutritive value of the three types of forage. The results are based on six digestion trials, two for each kind of feed obtained in different years. On the basis of the composition of the dry matter and the apparent digestibility a high quality roughage feed may be produced from preserving pea vines in either of the three ways. The choice of methods used by farmers depends largely upon climatic conditions and equipment available.

P10. Experience in Ensiling Partially Cured Alfalfa, Methods Used, Losses Sustained, and Feeding Value. J. B. SHEPHERD AND T. E. WOODWARD, Bureau of Dairy Industry, U. S. Department of Agriculture.

During the period June 2 to 8, 1937, a concrete silo 14 feet in diameter was filled to a depth of over 37 feet with 115,325 pounds of partially cured, first cutting alfalfa. The object was to see if partially dried hay could be readily stored and preserved in the silo and to see how the feeding value compared with a quality of hay which with good luck might have been made from the crop. The dry matter content of the alfalfa ranged from 42 to 73 per cent, averaging 56 per cent. The alfalfa was finely chopped (cutter set for ¼-inch cut). No water or other material was added. Two large loads of freshly cut alfalfa with 70 per cent moisture were run in on top. The top was weighted down with 50 pounds of additional weight per square foot of surface area.

The silo was opened on October 20 and the silage fed from October 21, 1937, to March 18, 1938. The settled silage was 30 feet 4 inches deep.

The maximum temperature reached during the storage period 6 feet below the surface was 109.4° F.

Spoilage on top was only 7 inches deep except right at the edge where it extended down 2 to 5 feet, averaging 3 feet. The total weight of the top spoilage was 4,445 pounds. This 4,445 pounds of spoiled material is probably the equivalent of 6,350 pounds of the green alfalfa as ensiled. This 6,350 pounds is 5.5 per cent of the total amount of alfalfa ensiled.

Below the top spoilage the silage was of excellent quality and all edible except for (1) a thin coating of mold varying from about 1 inch in thickness

to a thin film next to the wall in the upper half of the silo, due to the roughness of the concrete, and (2) limited areas of moldy silage around several silo doors. The average loss in weight of 55 samples, one from each load, buried in the silo was 3.10 per cent, principally dry matter. Analyses showed that most of the dry matter lost was nitrogen-free extract.

The carotene content of the alfalfa averaged 63.6 parts per million of dry matter when put in, and 47.75 when removed. The pH of the silage ranged from 4.61 to 4.78.

Two feeding trials of 60 days each were conducted to compare the value of the alfalfa silage and U. S. No. 2 leafy alfalfa hay as the sole roughage. The cows were given all the roughage they would consume. There was some excess which was weighed back daily. Enough grain (equal parts corn, oats, and wheat bran) was fed to approximate the Haecker feeding standard.

Averaging both feeding trials: The cows getting alfalfa silage consumed 7.6 per cent more dry matter in their roughage than the cows getting alfalfa hay. The milk production of the cows getting alfalfa silage declined only 15.6 per cent in 60 days, while the milk production of cows getting alfalfa hay declined 24.7 per cent. The average gain in live weight per cow was 16 pounds in 60 days for cows getting alfalfa silage and 18 pounds for cows getting alfalfa hay.

P11. Methods of Making and Feeding Alfalfa Molasses Silage. B. R. CHURCHILL AND R. E. HORWOOD, Michigan State College.

The successful preservation of high quality roughages in the upper peninsula of Michigan has always been a major problem. The adoption of a heavy roughage feeding program together with two successive years of small grain crop failures has made the problem even more acute. Investigations are being conducted at the Upper Peninsula Experiment Station at Chatham with ensiling as a possible method of preservation. Twenty-five tons of alfalfa molasses silage were ensiled in 1935 and a like amount again in 1936, using 1.5 per cent molasses. Dairy feeding trials with these lots of silage indicated that from a feeding standpoint, a satisfactory alfalfa molasses silage could be made. The trials also indicated that the biggest problem was the method of making the silage.

Twelve lots of legume silage were ensiled in September, 1937, to determine if possible the most satisfactory method of ensiling. Lots varied from none to three per cent molasses and with sugar replacing the molasses. Lots also varied as to stage of cutting and moisture content. The per cent of alfalfa was determined for each lot. Buffers were run on the hay put in and pH determinations made of the resulting silage.

A sample of each lot of silage was sealed in an air-tight container and placed in the center of each lot in the silo. Carotene determinations are being conducted on the sealed samples, on a sample taken from the center of each

lot and on a sample of artificial dried hay similar to that which was ensiled in each lot. The results thus far indicate that the sealed samples were high in carotene while the carotene content of the samples from the silo and those artificially dried were much lower. The loss of carotene is no doubt due to the presence of oxygen. In addition the per cent moisture, protein, and total fermentable carbohydrates were determined for the hay put in and the silage fed out.

All lots were fed to eight dairy cows, feeding trials covering four 30-day periods. In the first and third periods the silage was fed as replacement for 20 pounds of hay while in the second and fourth periods the silage replace 15 pounds of the hay in the ration. The feeding trials show the palatability of the various lots and results of the different feeding periods give some indications of the most practical method of feeding the silage.

When ensiled the lots varied from 72 to 80 per cent legumes. The moisture content varied from approximately 40 to 80 per cent. The per cent protein varied from 13.56 to 16.88. Preservation of carotene varied with the different lots.

This is a preliminary report of an experiment that will be completed May first.

P12. The Influence of the Quality of Protein in the Concentrate Mixture on the Production of Dairy Cows Fed Mixed Hay and Corn Silage. G. W. SALISBURY AND F. B. MORRISON, Cornell University.

Numerous experiments have proven that for swine and poultry, or for rats (used as laboratory test animals), the quality or kind of protein in a ration may be fully as important as the amount. Thus far but little information is available as to whether or not the quality of protein is of similar importance in dairy rations composed of the common feeds.

Corn gluten feed and corn gluten meal, which are common dairy feeds, both furnish protein of low quality for swine and rats. Corn gluten feed is often the cheapest protein supplement for northeastern dairymen. It is important, therefore, to determine whether the quality of protein is a limiting factor for high-producing dairy cows fed a ration made up of the common roughages grown in the northeast, the cereal grains, and corn gluten feed or other corn by-products as the only protein supplement.

During the winters of 1935–'36 and 1937–'38 experiments were conducted at the Cornell Station in which this question was studied. Each year two groups of nine cows of nearly equal productive capacity were selected. The cows were all fed mixed hay and corn silage. In 1935–'36 the hay was of better quality and contained more clover than the hay which was fed in 1937–'38.

One-half of the cows each year were fed a "low-quality protein" concentrate mixture composed of ground yellow corn, ground oats, corn gluten feed, corn gluten meal, bonemeal and salt.

The other cows were fed a "high-quality protein" concentrate mixture. It was composed of ground yellow corn, ground oats, soybean oil meal, corn gluten feed, linseed meal, dried distillers' corn grains, cottonseed meal, bonemeal and salt.

Results. Some concern was felt when the experiment was planned concerning the palatability of the "low-quality protein" mixture. However, no difficulty was experienced until the 13th week of the first experiment. Then two cows, receiving rather large amounts of concentrates because of their high production of milk went off feed. Up to and including this, the cows on the "low-quality protein" ration had produced 96.2% as much milk as the other cows.

When the "low-quality protein" group were fed the "high-quality protein" concentrate mixture the appetite of the two cows improved greatly. They also increased in production. These results suggested that a nutritive deficiency had become apparent in the "low-quality protein" ration after it had been fed for 13 weeks.

The experiment conducted this winter was similar except that the mixed hay contained a considerably smaller proportion of clover. Up to the present time (the end of the 15th week of the experiment) the cows on the "low-quality protein" ration have produced 107.0% as much milk as the cows on the "high-quality protein" ration. On no occasion have the cows refused the "low-quality protein" concentrate mixture.

P13. The Influence of Fineness of Grinding on the Coefficients of Digestion on Dairy Cows. T. M. Olson and G. C. Wallis, South Dakota State College.

The project herein reported was concerned primarily with the effect of fineness of grinding on the coefficients of digestion, and did not consider the effect of grinding grain on the cost of grinding, nor its effect on the production of the cows.

Four lactating cows were chosen and placed in special stalls where the digestion trials were conducted in the regular manner. The six trials were for 14 days with a 7-day preliminary period. The ration consisted of equal parts by weight of corn and alfalfa. The first, third and fifth trials medium fine corn was fed, in the second trial finely ground corn was fed, in the fourth trial whole corn was fed, and in the sixth trial alfalfa alone was fed.

The results with corn indicated that the coefficients of digestion for the entire ration were somewhat higher for the finely ground than for medium ground corn. The coefficients ranged from 1 to nearly 3 per cent higher for each nutrient, including the dry matter.

When the coefficients for the corn alone were computed, the difference in the finely and medium ground corn ranged from approximately 6 per cent in case of ether extract to 27 per cent for the fiber in favor of the finely ground.

The coefficients of digestion of the whole corn in the whole ration was appreciably lower than the ground corn with every nutrient, except crude fiber, ranging from 5 per cent for crude protein to 10 per cent for ether extract.

P14. The Relation of Certain Succulent Roughages to the Color and Flavor of Milk. H. H. TUCKER, O. F. GARRETT, C. B. BENDER, New Jersey Agricultural Experiment Station.

The results of the work at this station in 1936 and 1937 indicated that there was a good correlation between high yellow color and good flavor in milk. The results also indicated that molasses grass silage might be an excellent feed for producing milk with high yellow color. Accordingly experiments were designed in 1937–1938 to observe the effect of certain succulent roughages—beet pulp, corn silage, molasses grass silage, carrot-corn silage on color and flavor.

Two separate reversal feeding trials were conducted for the purpose of studying color. In the first experiment corn silage and poor quality field cured hay, grass silage and the same hay, and grass silage as the sole roughage were studied in which the following results were obtained. The color readings for each of the rations based on the mean of the color readings for the last week of each feeding period were, corn silage and hay 5.36, grass silage and hay 5.74, and grass silage 5.85. This means an increase in color of 7.71% in the milk produced on grass silage and hay over corn silage and hay, and 9.14% increase when grass silage was used as the sole roughage as compared with corn silage and hay.

In a second experiment corn silage and hay and grass silage and hay were compared with beet pulp and hay. Each feeding period was for 3 weeks with a one week transition period between changes of feed. A ration of beet pulp and hay was used at the start and end of the experiment. When the last week of each feeding period was compared with the last week of the previous depletion period, there was a color increase from 4.494 to 4.985 or 10.9% for corn silage and hay, and an increase from 4.271 to 5.190 or 21.5% for grass silage and hay.

Carrot-corn silage made from 1 part green carrots and tops and 3 parts green corn was fed to both groups following the completion of the above experiment in March 1938. This silage when fed with field cured hay increased milk color from a beet pulp value of 4.95 to 5.23 or 5.65% at the end of 3 weeks. All cows showed a gain in milk color, with greatest gains made by cows producing milk with lowest color.

The results of the experiment on flavor show that molasses grass silage is definitely superior to both corn silage and beet pulp and that corn silage is no better than beet pulp in this respect. The average flavor score for fresh

raw milk from individual cows for grass silage was 22.28, for corn silage 20.84 and for beet pulp 20.89.

There was also a definite association of high yellow color and good flavor.

P15. The Effect of the Level of Feeding Dairy Cows Upon the Flavor of their Milk. J. C. HENING AND A. C. DAHLBERG, New York Agricultural Experiment Station.

As an outgrowth of a cooperative experiment with the United States Department of Agriculture, a study was made of the effect of different levels of feeding upon milk flavors.

The cows were divided into six groups. One group as a control was fed at the Morrison standard and the other groups were fed at levels of 20 and 10 below and 10, 20 and 30 above the Morrison standard. The judging of the flavor of the milk from all of the cows in the experiment station Jersey herd, whether they were included in the cooperative experiment or not, was continued for one year. The raw milk was judged for flavor shortly after milking and the raw, pasteurized, and pasteurized plus copper milks were judged the first, third and fifth days after milking and pasteurization.

The study of the flavors for a complete year offered opportunity to note the effect of seasonal variations on the development of oxidized flavors. Six heifers freshened during the year and the flavor of their milk was compared with that of mature cows.

The results indicate, that, the flavor of the milk or the percentage of occurrence of oxidized flavor was not influenced by the level of feeding under the conditions of the experiment.

The occurrence of oxidized flavor, as has been shown by others, was considerably less in summer months than in winter months but there was not a direct correlation between the period of feeding green cut legumes and the occurrence of oxidized flavors.

The milk from first calf heifers showed a higher evidence of oxidized flavors than milk from older cows but the data was not considered sufficient to warrant definite conclusions being drawn.

P16. A Study of Some of the Physico-Chemical Effects of Soybeans on the Fat in Cows Milk. R. W. BRATTON, W. F. EPPLE, J. W. WILBUR AND J. H. HILTON, Purdue University.

Previous investigations at this Station have shown that raw soybeans, when fed in amounts equal to 25 per cent of the grain ration, effect a measurable increase in the fat test of the milk produced.

It seems logical, therefore, that this change in fat test would be accompanied by changes in the numbers of fat globules present or their size. Furthermore the chemical composition of the butterfat might change with the variation in the fat test.

A feeding trial has been in progress with the view in mind of determining some of the physical and chemical manifestations of this change in fat test.

Two cows were fed progressively on experimental rations consisting of one part corn, one part oats, and two parts roasted soybeans; one part corn, one part oats, and two parts raw soybeans; one part corn, one part oats, and enough soybean oil meal and soybean oil to make the protein and fat levels approximately equal to those of the raw soybean ration. The control ration consisted of one part corn, one part oats, and 1.5 parts soybean oil meal. Good quality alfalfa hay was fed as the sole source of roughage.

Microscopic examinations of the milk have yielded no conclusive evidence as to the probable effect of soybeans on either the total number or size of the fat globules. Sizes of the fat globules ranged from .1 to 15 microns in diameter, with the mean size between 1.5 and 3 microns. The total frequency ranged from 1.4 to 4.6×10^9 per ml.

Chemical analyses of the milk fat, including the iodine number, the thiocyanogen number, and the Reichert Meissl number, have yielded some information regarding the chemical nature of the increase in fat test.

The following table gives the average fat tests, the iodine and thiocyanogen numbers of the milk fat, and the calculated percentages of linoleic and oleic acid produced when the various soybean rations were fed.

Ration	% fat	I-no.	SCN-no.	% linoleic	% oleic
Soybean oil meal (check)	3.36	39.4	36.4	3.3	37.4
Soybean oil meal + soybean oil	3.58	45.8	41.7	4.5	42.1
Roasted soybeans	3.81	51.0	43.5	8.3	40.3
Raw soybeans	*3.88	43.2	39.1	4.5	39.2

* This slight increase in test over that secured when roasted beans were fed was caused primarily by an abnormally high test of one cow while she was sick during a period when raw soybeans were fed.

The figures in the above table indicate that the increase in fat test secured by feeding either raw or roasted soybeans was of about the same magnitude, but the composition of the resulting fat was noticeably different.

It is interesting to note further that when soybean oil was fed, the increase in test was not so great as when either raw or roasted soybeans were fed, but the composition of the fat resembled that produced by feeding raw soybeans.

The Reichert Meissl numbers which were determined, decreased when the iodine numbers increased. This change accompanied the increases in fat tests and indicates a diluting affect on the glycerides of the volatile fatty acids by some other fatty acids.

Additional studies are being made to determine if the increase in test is due to the oil in the soybeans or some other factor in the soybeans.

P17. The Vitamin D Content of the Milk Produced by Jersey and Holstein Cattle Receiving the Same Vitamin D Intake. G. C. WALLIS, So. Dak. State College.

The paired-feeding method is being employed with representative animals from the Jersey and Holstein breeds. Each animal is fed vitamin D at a known and constant level throughout the lactation period from natural food sources, chiefly alfalfa hay. The food intake is controlled so that each animal in a pair received the same amount of vitamin D. Butterfat samples representing the milk for a 4–6 day period are obtained from each animal at monthly intervals throughout the lactation period for vitamin D assay. The project will be continued until data is available from three or four pairs of animals. In this paper the results from one Jersey and one Holstein, which constitute the first pair, are being reported.

The alfalfa hay contained 1588 I.U. of vitamin D per pound. It was fed to each cow at the rate of 12 pounds per day making a vitamin D intake of approximately 19,000 I.U. daily throughout the lactation period. The vitamin D potency of the butterfat from the Holstein cow decreased from 0.43 I.U. per gram in the early part of the lactation to about 0.25 I.U. near the end. The Jersey showed the same tendency but the potency was always higher being 0.63 I.U. per gram in the flush of the lactation and 0.43 at the close. The decrease in the potency of the fat was practically counterbalanced in both cases by the increase in the percentage of fat in the milk as the lactation progressed so that the vitamin content per quart of milk was strikingly uniform throughout the lactation. The vitamin content of Jersey milk fluctuated between 27 and 33 I.U. per quart whereas the Holstein milk varied between 8 and 12 I.U. per quart. However, because of the larger milk production of the Holstein cow, the total amount of vitamin D recovered in the milk was practically the same for both cows. Of the 19,000 I.U. in the feed, the amount recovered decreased from about 1.8 per cent in the early part of the lactation to about 0.50 per cent toward the end.

P18. Plasma Magnesium Studies on the Growing Bovine. C. W. DUNCAN AND C. F. HUFFMAN, Michigan State College.

Determinations of magnesium were made on the blood plasma of 107 normal calves at intervals of 1 to 2 weeks over a period of 3 years and values were obtained for the mean concentration of magnesium for the first 18 months of life. The magnesium value showed fairly close agreement from month to month and a definite tendency to increase up to 12–13 months of age. The change in level was accompanied by a series of rhythmic variations which extended over several months. The mean value from the 2286 observed values was 2.414 ± 0.005 mg. per 100 cc. of blood plasma (range 1.62–3.83 mg.) and 79.7 per cent of the values were between 1.895 and 2.795

mg., whereas 72.5 per cent of all of the values actually occurred within the limits established by ± 1 standard error of prediction.

The same magnesium value recorded above were rearranged, without respect to age, into the respective calendar months in which they were taken and the influence of the astronomical seasons noted. Straight lines were fitted to the 6 means of January–June, inclusive, and July–December, inclusive, and the slope of each line represents the general path of plasma magnesium throughout the year. From November through April there was very little change in the mean but during May and June there was a rapid and steady decline. From July to November the downward trend was reversed and a steady increase in the concentration of magnesium took place. This decline and increase is particularly striking in view of the fact that some of the values were obtained from calves which did not have access to sunlight and were receiving different types of rations, so that the fluctuations in plasma magnesium are not referable to seasonal changes in the ration.

It has been shown that the concentration of magnesium can not be regarded as constant. The range of the so-called normal variation is sufficiently wide to include many variations that occur under pathological and physiological conditions. It is also evident that fluctuations in the plasma magnesium content of the blood of growing calves are to be expected as normal occurrences.

P19. The Normal Concentration of Inorganic Phosphorus in the Blood of Lactating Dairy Cows and Factors Affecting It. A. H. VAN-LANDINGHAM, H. O. HENDERSON AND G. A. BOWLING, West Virginia Agricultural Experiment Station.

Inorganic phosphorus has been determined on more than 200 composite samples of whole blood taken from twenty-two Holstein dairy cows at eight-week intervals over a period of two years.

The animals were divided into three groups depending upon the type of ration and management. All rations consisted of a grain mixture, supplemented with 2% bone meal, and alfalfa or timothy hay with or without corn silage. These rations were calculated to supply liberal amounts of digestible crude protein, total digestible nutrients, calcium and phosphorus.

There was no appreciable change in the inorganic phosphorus content of the blood throughout the first lactation, but there was a considerable drop during the last months of gestation preceding the second lactation period. The inorganic phosphorus in the blood was low during the first three months of the second lactation period. Again there was a drop in blood composition during the latter months of pregnancy preceding the third lactation period. During the first three months of the third lactation the blood phosphorus was low, but during the fourth to fifth months it rose to about the normal level followed by a slight decline throughout the remainder of the period.

There was a considerable decline in blood phosphorus from the first to the third lactation after which there was no appreciable change in blood composition. Sixty-two composite samples of whole blood taken during the first lactation averaged 4.95 mgs. per 100 mls., 51 samples taken during the second lactation averaged 4.81 mgs., 31 samples taken during the third lactation averaged 4.35 mgs., and 27 samples taken after the third lactation averaged 4.33 mgs. of inorganic phosphorus per 100 mls.

There was a slight negative correlation between the inorganic phosphorus content of the whole blood and the average daily milk production in pounds for the entire lactation period.

The inorganic phosphorus in the blood of lactating dairy cows was slightly lower during the winter and early spring than during the summer and early fall. This difference was not related to feed or management of the animals.

P20. The Carotene Content of Market Hays and Corn Silage as Determined by a Quantitative Adsorption Procedure. LEO A. SHINN, HERBERT G. WISEMAN, EDWARD A. KANE AND C. A. CARY, Bureau of Dairy Industry, United States Department of Agriculture.

When the pigments that occur with the carotene in the feed are separated from it by a modification of the Willstätter and Stoll procedure, using 92 per cent CH_3OH in the removal of the xanthophyll, the carotene content in milligrams per kilograms with U. S. No. 1 alfalfa hay varies from 19 to 121, average 43; with U. S. No. 3 alfalfa, from 1 to 11, average 4.5; with U. S. No. 1 timothy hay, from 8 to 36, average 21; with U. S. No. 3 timothy hay, from 1 to 12, average 5.5; and with corn silage, from 1 to 40, average 13.7.

With none of these materials does the spectral absorption curve for the pigments in the "carotene" fraction correspond with that of β-carotene within the limit of experimental error. The absorption is relatively too high at wave lengths shorter than 450 mμ, and too low at wave lengths longer than this to correspond with this carotene.

If these carotene fractions are filtered on adsorption columns in such a way as not to destroy any of the pigments in them, two colored fractions may readily be obtained—one with the spectral absorption of β-carotene and the other, probably made up of several pigments, with a spectral absorption that would account for the discrepancy between that of the original unfiltered sample and β-carotene; and the amount of carotene obtained in this way from the original, unfiltered carotene fractions is the same as that calculated, from the spectral absorption curve of β-carotene and that of the impurity removed by filtration, to be present in them. An adsorption procedure has, therefore, been devised for the routine determination of carotene in feeds. For U. S. No. 1 alfalfa hay, it gives results on an average of 18

per cent lower than those above; with No. 3 alfalfa, about 39 per cent lower; with U. S. No. 1 timothy hay, 25 per cent lower; with No. 3 timothy hay, about 40 per cent; and with corn silage, 30 per cent lower. The above figures, corrected accordingly, probably represent more nearly the vitamin A potency of these feeds.

P21. Relationship Between Carotene, Blindness Due to Construction of the Optic Nerve, Papillary Edema and Night Blindness in Calves. L. A. Moore, Michigan Ag. Exp. Station.

For the past 20 years various experiment stations have noted blindness in calves associated with rations where poor quality or no roughage was fed. The condition is also associated with poor reproduction. Previous work from Michigan has shown that the blindness is associated with a constriction of the optic nerve where it passes through the optic foramen. Further work with calves has shown the blindness is preceded by papillary edema and generally by night blindness.

Excellent work from California has shown the association of vitamin A and night blindness in cattle. Various workers have associated vitamin A deficiency and blindness due to constriction of the optic nerve although no direct proof has been produced. Two Holstein calves placed on a vitamin A deficient ration (a ration which had previously produced the blindness) and fed crystalline carotene dissolved in cottonseed oil in quantities sufficient to keep the blood plasma carotene level well above a lower limit of 0.13 gammas per cc. have not developed night blindness, papillary edema or blindness due to constriction of the optic nerve. It therefore appears that vitamin A deficiency is the cause of the development of these conditions.

In mature cows night blindness and papillary edema develop but blindness due to constriction of the optic nerve does not develop due to the fact that the optic canal is well calcified and is not growing in length.

In calves blindness due to constriction of the optic nerve and papillary edema are associated while night blindness is a separate process but due to the same deficiency.

P22. The Carotene Requirements for Normal Reproduction. H. T. Converse and Edward B. Meigs. Bureau of Dairy Industry, United States Department of Agriculture.

In 1936 Meigs and Converse reported before this society the results of their work on the carotene requirements of dairy cattle for reproduction and lactation. The roughages which furnished the carotene for the animals used in that work constituted approximately half the ration. With U. S. No. 1 alfalfa hay there was a normal number of normal calvings; with U. S. No. 3 alfalfa or timothy hay, all calvings were abnormal where the animals had been on these rations for 5 months or more; and it was reported that with

U. S. No. 1 timothy hay or U. S. No. 1 clover hay (or clover light timothy mixed) less than 50 per cent of the calves were normal at birth. The average daily carotene intake of the cows on the No. 1 timothy and No. 1 clover rations was probably about 50 milligrams per animal or 100 micrograms per kilogram of body weight. This was calculated by using average figures for these two grades of hay. As there is a wide variation in the carotene content of hays of the same grade, and as considerable loss of carotene occurs during their storage, it seemed desirable to obtain more definite information on the effect of hays supplying approximately this apparently critical level of carotene.

We have, therefore, noted the carotene intake, during the last 3 months of gestation, of all cows on rations of grain and No. 1 timothy hay or grain and No. 1 clover or clover mixed hays. Seven calvings have occurred. All have been apparently normal. The carotene intake was from 80 to 130 milligrams daily or from 178 to 260 micrograms per kilogram or body weight. Two other cows on a ration containing clover hay had a daily carotene intake for the last 3 months of gestation of about 30 milligrams (60 to 70 micrograms per kilograms of body weight) gave birth to very weak calves, though one did survive. One first-calf heifer on timothy hay received about 90 milligrams of carotene daily at the start of gestation and about 42 milligrams daily at calving. This carotene intake represented 340 micrograms per kilogram of body weight at conception and 114 micrograms per kilogram at calving. The calf was born dead. As previously reported, no cows on our lower grades of timothy hay have calved normally.

Our amounts of carotene for safe calving are therefore somewhat larger than those reported by Guilbert and Hart of California.

We conclude that for normal calving, cows should receive during the last months of gestation 80 to 100 milligrams of carotene daily. If the daily carotene intake is as little as 60 milligrams per cow there will probably be a considerable proportion of dead calves.

P23. Vitamin A for Growth and Reproduction in Dairy Heifers. I. R. Jones and J. R. Haag, Oregon State College.

The possibility of dairy heifers being fed rations too low in vitamin A for good growth, normal reproduction and well-being has been indicated by the investigations of several workers in recent years.

In the fall of 1936, thirty purebred dairy heifers were placed on a basal ration consisting of poor quality oats and vetch hay and a grain mixture composed of barley, oats, wheat bran, linseed oil meal, bone meal and salt. The oats and vetch hay was quite mature when cut and was rained upon and bleached during the curing process. This hay was found to contain about nine parts of carotene per million. Preliminary vitamin A assays with rats gave results of essentially the same order.

The heifers, ranging in age from 6 to 20 months and previously maintained on good rations, were divided into two similar groups, one of which was fed in addition to the basal ration, a vitamin A supplement in the form of salmon oil at the rate of 5 c.c. per hundred pounds live weight daily. Rat assays indicate that the salmon oil has a vitamin A potency of about two times that of U. S. P. XI Reference Cod Liver Oil.

All heifers were fed individually and accurate records kept of feed consumption, breeding behavior, health and growth. The heifers of both groups continued to grow at essentially the normal rate during the 6 months' period.

The reproduction records of the two groups of heifers have been fairly normal with a possible benefit to be attributed to the salmon oil feeding. Three heifers receiving salmon oil and 2 controls successfully continued pregnancy from about the fourth month until 3 to 4 weeks before calving when they were given a better quality hay and corn silage. Five salmon oil fed heifers and 2 controls became pregnant while receiving the experimental rations. Delay in estrus and failure to conceive at service were somewhat more prevalent in the control group.

The heifers that had not freshened were pastured for 6 months in the summer of 1937. Five heifers calved normally during this period. Five salmon oil and 11 control heifers became pregnant while on pasture.

In the fall of 1937, fourteen of the original heifers, 7 in each group, were again placed on similar experimental rations. Also, an additional 24 heifers averaging 9 months of age, were paired into two groups. The hay fed in 1937–38 was a mixture of poor quality oats and vetch and sudan grass with an average carotene content of about 11 parts per million.

After 4½ months' feeding, the weights and heights of all animals are normal. The heifers bred while on pasture have successfully completed pregnancy. Other reproduction records are incomplete. No harmful effects have been observed as the result of feeding as much as 60 c.c. of salmon oil daily.

The experimental results would seem to indicate that a comparatively low vitamin A ration will not result in serious disturbances in dairy heifers when fed over a period of about six months either preceded or followed by a pasture period.

P24. The Value of Dried Molasses and Yeast for Dairy Calves. O. L. LEPARD, P. E. NEWMAN AND E. S. SAVAGE, Cornell University.

In view of the introduction of dried molasses and yeast as a dairy feed and previous published results concerning the value of cereal yeast for dairy calves, studies were made to determine the relative replacement value of dried molasses and yeast for skimmilk in dairy calf starters.

Two lots of 5 calves each were raised by the calf starter method. Each calf received 350 lbs. of whole milk allotted over the first 7 week period. Calf starter was fed free choice to a maximum of 4 lbs. per day for the first

16 weeks. As soon as the calves reached 4 lbs. of calf starter a heifer ration was fed to a maximum of one pound per day until the calves were 16 weeks of age. At 16 weeks of age the calf starter was discontinued and the heifer ration fed to a maximum of 5 lbs. per day for the remainder of the trial. Alfalfa heavy grass mixed hay, U. S. Grade No. 2, was fed free choice throughout the experiment. All experimental trials were of 20 weeks' duration.

To test the value of dried molasses and yeast as an ingredient in calf starter one group was fed 5% dried molasses and yeast replacing an equal amount of dried skimmilk in a previously tested formula containing 20% dried skimmilk. The other group was fed 7.5% dried molasses and yeast replacing 5% of dried skimmilk in a calf starter formula containing 10% dried skimmilk.

The group receiving 5% dried molasses and yeast consumed 227.1 lbs. of total digestible nutrients per 100 lbs. of gain as compared with 238.5 lbs. of total digestible nutrients for the check group containing no yeast. The average daily gains from 2 weeks of age for this group was 121.6% normal as compared to 110.1% normal for the check group.

The group receiving 7.5% dried molasses and yeast consumed 231.9 lbs. of total digestible nutrients per 100 lbs. of gain as compared with 254.1 lbs. of total digestible nutrients for the check group containing no yeast. The average daily gains from 2 weeks of age for this group was 118.7% normal as compared to 112.2% normal for the check group.

All calves appeared normal and in a thrifty growing condition throughout and at the end of the experimental periods.

Dried molasses and yeast is hygroscopic in nature and contains 32% mineral ash. Each of these factors may offer some difficulty when large amounts are used in a ration.

P25. Initiation of Lactation in the Albino Rat. R. P. REECE, New Jersey Agricultural Experiment Station.

A number of investigators have reported the failure to initiate lactation in the albino rat, either with an anterior lobe extract or with lactogen. Two possibilities have existed to account for this non-functional responsiveness: first, that the experimentally developed mammary glands of the albino rat were not developed to a state entirely comparable to that which takes place during pregnancy and secondly, that the albino rat was non-responsive to lactogen.

This problem has been re-investigated. Pseudo-pregancy was induced in rats by injecting a gonadotropic hormone. On the 12th day following the induction of pseudo-pregnancy the animals were ovariectomized and a mammary gland removed. Experimental animals were then injected with pituitary glands, anterior lobe acetone dried powder or lactogen every eight

hours until six injections had been made. Three or four hours following the last injection the animals were sacrificed and their mammary glands observed macroscopically and microscopically. Control animals were employed also and they received the same treatment as experimental animals except that no injections were made following ovariectomy.

Lactation was observed in none of the control animals. In the experimental animals a small amount of milk was observed following the injection of lactogen, pituitary glands from spayed female rats and pituitary glands from normal rats. A fair amount of lactation was observed in experimental animals following the injection of pituitary glands from normal and ovariectomized rats which had been injected previously with estrogen. In not one case was lactation observed which was comparable to which occurs in the parturient female rat.

A group of pseudo-pregnant rats were then injected daily with 200 i.u. of estrogen during the pseudo-pregnancy period. The experimental animals were then injected with an acetone dried powder made from cattle pituitaries. In all cases lactation was observed which was comparable to that observed in the rat following parturition. Lactogen injections into similarly treated rats resulted in inconsistent results.

These observations demonstrate that the mammary glands of rats are functionally responsive to injected pituitary tissue and emphasize again the importance of anterior pituitary hormones, other than lactogen, in initiating lactation.

P26. Recent Advances in Our Knowledge on the Endocrine Control of Mammary Development. E. T. Gomez and C. W. Turner, Missouri Agricultural Experiment Station.*

Until recently, development of the mammary gland had been assumed to be stimulated directly by ovarian hormones. Gomez, Turner and Reece (1937) first demonstrated, that while normal development of the mammary gland could occur only in the presence of functional ovaries, the action of ovarian hormones (estrogen and progestin) is indirect, by way of the anterior pituitary gland. These observations have since been confirmed and extended to several species of laboratory animals (Gomez and Turner, 1937–1938). Studies with hypophysectomized rats, rabbits, cats, and guinea pigs maintained under strict hygienic regimen and nutritive care have shown that administration of estrogen and/or progestin daily for periods ranging from 20 to 30 days was ineffective in stimulating growth of the mammary gland. Similarly, administration of somewhat purified preparations of anterior pituitary hormones, including the thyrotropic, adrenotropic, gonadotropic,

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and lactogenic hormones; the thyroid (thyroxin) and adrenal cortical (eschatin) hormone; and acetone dried or fresh anterior pituitaries of sheep alone and in combination with estrogen or estrogen and progestin was ineffective in stimulating the growth of the mammary gland. These observations were interpreted as indicating that estrogen and/or progestin stimulates the production of a specific mammary gland growth-promoting hormone which in turn exerts a direct action upon the mammary gland. This hormone entity has been called "Mammogen." According to the above hypothesis, the pituitaries of animals during estrum and pregnancy or those which have been receiving estrogen treatments should contain a high concentration of this mammogenic hormone. Sufficient evidence has now been accumulated to confirm and extend this hypothesis.

Implanation of one adult male rat pituitary daily for 20 days produces extensive arborization of ducts and proliferation of the lobule-alveolar system of the mammary gland of hypophysectomized immature male and female guinea pigs. The donor rats have previously estrogen treatments daily for 10 to 20 days. On the other hand, implanation of one adult normal male rat pituitary daily for 30 days is effective in stimulating the mammary glands of hypophysectiomized guinea pigs. Daily administration of 50 mgs. of macerated anterior pituitary from pregnant cattle for 20 days or more causes the growth of ducts and proliferation of the lobule-alveolar system of the mammary gland of gonadectomized immature female rats and rabbits. This growth is comparable to that observed in late pregnancy.

Summary.—The normal development of the mammary gland is under the direct influence of a "mammogenic hormone entity" of the anterior pituitary gland. This hormone entity is elaborated in ample amount by the pituitary gland, to produce physiological effects upon the mammary gland following injection of ovarian hormones or during pregnancy.

P27. The Biological Assay of "Mammogen." A. A. Lewis and C. W. Turner, Missouri Agricultural Experiment Station.*

The normal male mouse at about puberty (10 to 25 grams body weight) has 8 to 10 very rudimentary mammary glands, without teats. These consist of one to three thin ducts with perhaps a few short side-branches.

Subcutaneous injection of fresh, macerated anterior lobe tissue from pregnant animals in water in the lumbar region of normal male mice (castration is unnecessary) once daily for a minimum of four days has been found to stimulate the mammary glands to the development of thick ducts, numerous side branches, and large club-like, dark staining end-buds. Not all of the glands on a mouse skin will develop to the same extent. Those at the anterior end usually respond most readily.

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The total dosage necessary to secure such development can be reduced by injecting smaller amounts daily for six days. The mice are then killed on the seventh day and the skins mounted on cork and placed in a fixative. The interior fascia is later removed, stained, and examined under a binocular microscope. One or more well developed glands with large end-buds, denoting rapid growth, is considered a positive response. Because of variability in the mice, response should be secured in 50 ± 10 per cent of ten mice.

Formulative of an assay technique is facilitating determination of comparative concentrations of "mammogen" in different extracts, in the pituitaries of different species, and at different stages of pregnancy. Work is also progressing on methods of chemical extraction and purification. The response to "mammogen" of other mammalian species is also being investigated.

Summary.—The male mouse, of between 10 and 25 grams body weight, which invariably has very immature glands, has been found to be an excellent assay subject for the mammogenic factor of pregnancy pituitaries. The proposed assay unit is the total amount of pituitary tissue or extract, injected subcutaneously for six successive days, necessary to secure pronounced end-bud development on at least one gland each of 50 ± 10 per cent of ten normal 10 to 25 gram male mice.

P28. Milk and Fat Production of Dairy Cows as Influenced by Thyroxine, and Anterior Pituitary Extracts. NOEL P. RALSTON AND H. A. HERMAN, Missouri Agricultural Experiment Station.*

Recent experiments at this and other stations have demonstrated an augmentation of milk and fat secretion when cows are administered thyroxine, and extracts of the whole anterior pituitary body. In general, previous experiments have been of short duration, but have served to further emphasize the relation of the endocrine secretions with respect to the functioning of the mammary gland.

The present project has as its objective (a) a further study of the influence of thyroxine and other thyroid substances on milk and fat secretions; (b) the effect of extracts of known potency from the whole anterior pituitary, on milk and fat secretion; and (c) the relative effects of some of the fractions of the anterior pituitary on milk secretion. Included in this study is the determination of the minimum dosage of the respective hormone substances required to bring about a maximum response in increased milk and fat yield at the various stages of lactation. Cows in the various stages of lactation, and of high, low and intermediate producing ability have been selected for these experiments.

Monthly injections of thyroxine, given in three successive doses of 10 to 15 mg. daily, have been found to give an increase of 10 to 20 percent in milk

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yield. The maximum increase is usually attained within five to six days following the beginning of thyroxine administration. Milk secretion continues at an elevated level for 10 to 12 days following the treatment and gradually returns to the pre-injection level. The fat percentage has increased rather markedly with a slight increase in solids-not-fats. Cows in the early decline of lactation appear to give the most pronounced increase in yield.

Preliminary work with whole anterior pituitary extracts demonstrates that large doses are necessary to obtain an increase in milk yield. However, the size of the dose varies considerably with different cows and with the stage of lactation. Cows in the early stages of lactation have shown indications of making the greatest increase in yield following treatment.

The work at present has not progressed to the extent of permitting definite conclusions as to the maximum response obtained by uniform dosages of these hormone substances administered at the various stages of lactation.

P29. Vitamin C Metabolism in the Dairy Cow. W. H. RIDDELL AND C. H. WHITNAH, Kansas Agricultural Experiment Station.

It has previously been reported from this station that the change from winter feeding to spring pasture did not increase the vitamin C content of milk. What effect then has the increased intake of vitamin C on the vitamin C metabolism of the dairy cow?

The following effects were noted in three cows which were changed from a winter ration to all the green rye they would consume.

1. The vitamin C intake increased regularly for ten days to a maximum of over sixty grams per day.
2. The average vitamin C content of the blood more than doubled within twelve hours after the green feed was first supplied. The blood level reverted to normal within the next twelve hours.
3. The average output of vitamin C in the urine was increased over five-fold within sixty hours after green feed was first supplied.

The fate of vitamin C was studied in the rumen contents of a cow with a rumen fistula, and in a steer at slaughter. In each case the rumen contents contained less than one-tenth the vitamin C of grass ingested twelve hours earlier. The solid and liquid portions of any sample of the rumen contents contained equal concentration of vitamin C.

The early rise of vitamin C in blood and urine, and its rapid disappearance from the rumen, suggest that the vitamin was rapidly absorbed. The first two of these changes also suggest that an ample supply was available even to cows on winter feed. The return of blood to normal levels, the failure of urinary output to continue increasing, and the failure of vitamin C output in milk to increase, all indicate that the increased intake may have been compensated for either by decreased synthesis or by increased destruction.

P30. Fat Metabolism of the Mammary Gland. J. C. SHAW AND W. E. PETERSEN, University of Minnesota.

Blood fat arterio-venous differences were determined in numerous experiments. There was a consistent and comparatively large loss in blood fat as determined by Allen's (1934) method. The arterio-venous fat loss did not show any relationship to either arterial blood fat level or quantity of milk secreted. However, the arterio-venous fat differences increased with the increase in period of time following milking.

The arterio-venous fat loss was sufficient to account for all of the fat in the milk as shown by the relation of fat arterio-venous differences to the arterio-venous loss of calcium, and the combined loss of glucose and lactic acid, when it is postulated that some of the fat is used as a source of energy for the gland by oxidation, which in turn will account for the lower fatty acids found in milk fat.

P31. Enzymatic Relationship to the Synthesis of Milk Fat. PHILIP L. KELLY, University of Arkansas.

A previous study indicated the presence of sufficiently large amounts of free fatty acids in the bovine mammary gland to suggest that they played a significant part in the actual processes of milk fat secretion. It was thought that their presence might come about by the action of enzymes on the blood fat constituents, and a study was made to determine this point.

Three glands were used in the study. Samples of tissue from each gland were heated in a water bath to over 75 degrees C. for the purpose of stopping enzyme action. These samples served as controls. These and additional samples which were not heated were mixed with portions of ethyl-butyrate and toluene, and allowed to stand at room temperature for a period of not less than five days. They were dried with calcium sulphate and extracted with ethyl ether. The concentrated extract was made up to volume with petroleum ether, and the acid value was calculated from aliquots of this material in each determination. Each analysis was made in duplicate. The necessary blank analysis was determined in each case.

The following table gives the acid values of the mammary gland fat under the various conditions of the experiment.

Gland number	Condition of the gland	Acid value fat of fresh tissue	Acid value fat of heated tissue	Acid value fat of unheated tissue
1.	Lactating	34.0	38.5	88.2
2.	Lactating	39.7	54.5	90.5
3.	Non-lactating	17.4	26.4	154.1

In each instance there were very marked differences in acid value between the samples of heated and unheated tissue. The evidence obtained indicates

that enzyme action may be responsible for the presence of free fatty acid in the secretory tissue of the bovine mammary gland.

P32. The Effect of Fasting and Refeeding on Milk Secretion in the Cow and Goat. L. E. WASHBURN, Department of Dairy Husbandry, University of Missouri, Columbia, Missouri.*

Data on yield of milk and percentage of milk constituents indicate a remarkable persistency to maintain lactation during fasting in the cow and goat. Certain data also show that fasting may have a beneficial effect on later milk secretion. While levels of fasting energy metabolism are approached at the same rate in these animals, declines in milk secretion proceed at different rates. At 72 hours after feed, in the cow, milk yield has declined 50% and fat percentage has increased 100%; in the goat, milk yield has declined 80% and fat percentage has increased about 400%. Milk yield and percentages of constituents return rapidly to original pre-fast values upon refeeding.

P33. The Course of Fasting Energy Production Curves in the Lactating and Dry Dairy Cow Under Similar Environmental Conditions. L. E. WASHBURN, University of Missouri.†

Preliminary studies indicate that, under similar conditions of treatment and environment, the fasting energy production of a lactating dairy cow is of the order of 10% higher than that of the dry cow. This difference is quite constant until about 60 hours after feeding. The heat production of both cows declines 47%, and reaches a level at 36–48 hours after feed. While this level is maintained by the dry animal, the heat production of the lactating animal further declines about 16% after 60 hours. Milk yield decreases about 50% during 72 hours of inanition, but the fat production remains at a remarkably constant level.

These studies seem to show that in the dairy cow (1) lactation as a function is maintained within certain limits of inanition; and, (2) the higher energy metabolism of the lactating animal is due in a large measure to specific dynamic effect of the food. It is believed that lactation stimulus, endocrine or otherwise, acts to a considerable degree upon the alimentary system of the animal.

P34. Nature of Swelling in the Cow's Udder at Calving Time. W. W. SWEET, C. A. MATTHEWS AND R. R. GRAVES, Bureau of Dairy Industry, U. S. Department of Agriculture.

Opinions differ as to the extent to which the intensity of swelling in the udder at parturition interferes with the normal functions of the mammary

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glands and with maximum milk secretion. Recently a cow was slaughtered soon after she had calved, when her udder was in an extremely swollen condition with the cool, plastic kind of swelling in which pressure with the finger tip leaves a persistent indentation. The cow was a slow, hard milker. She produced as much as 74 pounds of milk in one day and a total of 520 pounds of butterfat for the year as a 4-year old. A pronounced udder swelling accompanied by marked abdominal swelling occurred at each of her four calvings. At the fourth parturition the size of the udder reached extreme proportions.

Although the udder was milked out immediately before the cow was killed, the amputated udder weighed 165 pounds. The fluid-holding capacity of the udder was 111 pounds. An incision between the right and left halves showed a layer of swelling about 2 inches thick between the skin and the glandular tissue. The surfaces exposed by the incision indicated that the material making up the swelling consisted chiefly of a clear fluid in which there was a network of fine silky fibers, glistening in appearance, and resembling spider's web. The fluid was tenaciously held and did not escape. The swelling obviously was edematous in character. Histological studies indicated that the swollen material contained an interwoven mass of fibers, and that the swelling did not invade the adjacent glandular tissue to any appreciable extent. All four quarters of the udder were functioning at the time of slaughter and aside from the edematous swelling there was nothing to indicate any significant abnormality.

P35. Some Factors Affecting the Resistance of Animals to Mastitis.

LLOYD A. BURKEY, EDWARD B. MEIGS, GEORGE P. SANDERS AND MORRISON ROGOSA, Bureau of Dairy Industry, U. S. D. A.

A study was made of the number of leucocytes present in the milk, the germicidal property of the milk and the inhibitory action of bovine blood serum against *Streptococcus mastiditis* in an effort to evaluate these agents as natural resistance factors against mastitis.

Results obtained show that large numbers of leucocytes in milk indicate an injury to the udder, but not necessarily the presence of an infection. Leucocytes appear to act as effective agents against infection in some cows, while in others infection is delayed for a number of months or until a general breakdown in animal resistance takes place.

The germicidal property of the milk differs in individual cows and in the different quarters of the same cow. There is also a tendency for this property of milk to increase with the increase in the severity of the disease and with the increased numbers of leucocytes until the acute stage of mastitis is reached. After this point the milk contains less germicidal substance.

Bovine blood serum contains a factor inhibitory to the growth of *Streptococcus mastiditis* in milk of the same cow in vitro. This factor is ineffective

after the serum is 4 or 5 days old and when added to milk from a cow other than the one providing the serum. The inhibitory power of blood serum decreases rapidly with increased symptoms of mastitis and appears to be intimately related to animal resistance. Blood serum lacking in this inhibitory factor acts as a medium and therefore enhances the growth of *S. mastiditis* in vitro. The combined action of the germicidal property of the milk and the inhibitory factor of the blood serum produces a greater retardation of growth of *S. mastiditis* in vitro than is produced by each separately.

The extent to which these inhibitory factors in vitro are identical in their action in the udder and just how significant they may be as factors in the resistance of the animal to the invasion and growth of *S. mastiditis* permits considerable speculation. It is possible that an injury resulting in the increase of chlorides in the milk may at the same time bring about an inflow of blood serum in the udder. It is conceivable under such a situation, which may be quite common, that this effect would result in either a protection against infection or more favorable conditions for growth of *S. mastiditis* in the udder. Results obtained, when milking machines were used at high vacuum, showed an increase in the percentage of chlorides in the milk and an increase in the incidence of mastitis.

Results obtained in the study of these factors indicate that they may be significant defense agencies against infection. Further studies are needed to determine the manner in which these animal defenses may be fortified by animal management to make them more effective safeguards against infection.

P36. Preventing Sudan Grass Poisoning. FREDERICK BOYD, O. S. AAMODT, G. BOHSTEDT AND E. TRUOG, University of Wisconsin.

During the past year a method for determining the amount of prussic acid present in plant tissues has been developed which is simple, fairly rapid, and is believed to be considerably more reliable than some of the other methods which have been proposed. This method may be referred to as a "chloroform-steam distillation-picrate colorimetric" procedure. By this test several hundred farmers' samples of sudan grass have been analysed for prussic acid during the past year, together with great many samples from experimental plots.

The findings are as follows: Short, dark green sudan grass is at times so high in prussic acid, or hydrocyanic acid, as to be dangerous to pasture. Second growth after pasturing or removal of a hay crop when short and dark green is especially dangerous. Sudan grass which is 1½ feet or more in height is usually low in hydrocyanic acid and is relatively safe to pasture. Sudan grass, short or tall, which is of a pale or yellowish green color is low in cyanide poison and is relatively safe to pasture.

A high level of available nitrogen and a low level of available phosphorus in the soil tend to increase the poison content in plants, while a low level of available nitrogen and a high level of available phosphorus have the opposite effect. A high cyanide content may, however, still occur in short plants, especially in the second growth, even though the level of available phosphorus is high.

Drought probably operates as a factor, largely, by keeping the plants small in which stage they are always much higher in cyanide than when larger.

When sudan grass is dried and made into hay, the cyanide poison content does not change greatly. Since it is usually not cut for hay until it reaches a height of three feet or more, there should be little if any danger from cyanide poison in sudan grass hay.

Cattle when turned into sudan grass of high poison content usually stop eating after about 15 minutes, due to the action of the poison. If the animals are not too hungry and are in a high state of vigor, they usually stop eating before they take a fatal dose. If they are in a low state of vigor and very hungry, they are more apt to eat a fatal dose.

For this reason it is important that cattle be given some other feed previous to turning them into a sudan grass pasture, when this is done for the first time during a pasture season. As an added precaution, it is a good plan to watch the herd for an hour on being turned into a field of sudan grass. If some of the animals stop eating sudan grass after a few minutes, or look around for other grass to eat, it is a good sign that the sudan grass is dangerous.

P37. A Report of the Occurrence of Four Cases of Agnathia. FORDYCE ELY, H. B. MORRISON AND F. E. HULL, Kentucky Agricultural Experiment Station.

Agnathia or an agnathic condition, according to Webster, describes a case where the jaw is absent or deformed. During the past two years three male calves have appeared in the Kentucky Agricultural Experiment Station herd, and one in a related herd, whose lower jaw and tongue anterior to first premolar are entirely lacking. The calves in the Experiment Station herd were all by the same sire and also closely related through their dams. A genetic analysis is presented showing relationship coefficient between afflicted calves according to formula of Lush.

One of the calves was carried for a normal gestation period, another was discovered in the uterus of a cow slaughtered in another experiment; a third calf was discovered as an aborted fetus from a Bang's disease negative heifer. A fourth agnathic male calf has come to the attention of the authors in a Western Kentucky breeder's herd. The sire was from the Experiment Station herd and the afflicted calf carries a concentration of the same blood as the first mentioned calves.

Other anatomical data on three of the calves are presented. The heads and hearts show identical abnormalities which are described in some detail.

P38. Maximum Initial Yield and Persistency as Inherited Characters Influencing Total Lactation Yield. LESTER O. GILMORE, WM. E. PETERSEN AND J. B. FITCH, University of Minnesota.

A review of the literature reveals that there are almost as many opinions against the idea that inheritance affects persistency and initial maximum yield as there are opinions and data in support of it. The data represented in this report were taken from a study of the generally considered influences on persistency. They are presented here because they represent a different type of analysis and because they seem conclusive.

The data were taken from the records of the University herd and from a cow testing association. The former herd is managed under a standard plan, adopted in 1923, in which it is aimed to provide as standard an environment as possible in regard to age of calving, lactation during which cow is on official test, duration of test period, frequency of milking and ration utilized. The C. T. A. records all came from a herd larger than the average in which conditions of good management were known to prevail and in which the usual exigencies of poor crop yields were minimized.

In the analyses there was a breakdown of the data, first according to breeds and secondly according to the sires within the breed. Thirdly, for sires having a relatively large number of daughters, the production of the daughters was grouped according to the sire of the dams of these daughters.

With three-time-a-day milking one group of daughters averaged 19 per cent more milk in a year than did the daughters of another bull. Both groups started out at approximately the same initial yield, the difference consequently being ascribed to the difference in persistency that resulted. One group of a sire's daughters averaged 32 per cent more milk a year than did another group of the same sire's daughters, the grouping being made according to the sires of the daughter's dams. The persistency was similar in the two groups but there was a marked difference in the initial maximum yield. The significance of this difference is increased by the fact that one group of these dams was purchased and the differences between this group of daughters and each of the other groups are consistent. It is known that selection in the herd from which these purchases originated was not based primarily upon production. The smaller differences in initial yield of daughters from cows developed in the University herd show some of the effects of selection of sires over a long period, on the basis of their daughters' production. The graphs presented indicate that hereditary factors affecting initial maximum yield and persistency are inherited independently.

P39. Herd Averages Computed by the Cow-Year Method Versus Herd Averages Based Only on Cows on Test at Least 10 Months. JAY L. LUSH AND FLOYD JOHNSTON, Iowa State College.

A survey of Iowa C. T. A. Herds including 114 herd years indicates:

1. Cows entering the herd during the year average more on the cow-year basis than do cows which are in the herd all year. (Presumably their age handicap is more than offset by the absence of dry period and by the fact that it tends to be the flush part of their lactation which is included. Probably the records are higher than the real abilities of the cows.)

2. Cows leaving the herd during the year average less on the cow-year basis than do cows which are in the herd all year. (Presumably some of these have been sick and many have been in the later stages of their lactations. The records are probably poorer than the cow's real abilities.)

3. Cows on test between 10 and 12 months of course average more on the cow-year basis than they do if each such cow is counted as a unit in computing the average.

4. The bias from 1 almost exactly cancels that from 2 when large numbers are involved but of course will not always do that in individual herds.

5. Only about 60 to 70 percent of the total number of cows in the herd at some time or other during the year are in it for more than 10 months of that year. A herd average based only on those cows which were on test at least 10 months will sometimes be erratic because of the small number of animals included.

6. Which method will most accurately indicate the average genetic ability of the herd depends mainly on whether in individual herds the errors from 5 are usually larger than the errors from 1 failing to balance 2.

P40. Age and its Influence on Culling and Life Expectancy in Dairy Cows. D. M. SEATH, Kansas State College, and J. L. LUSH, Iowa State College.

In a study of 147 Iowa cow testing association herds for the years 1931 to 1935 inclusive, it was found that an average of 29 per cent of the cows left these herds each year. This included cows leaving for all reasons, *i.e.*, disease, low production, injury, death, dairy purposes, *et cetera*. In classifying the cows for a particular year, those remaining in the herd for the entire year following were called non-culls, while those leaving before the completion of the following year were classified as culls.

Of the cows under eight years of age, the two and three year olds were culled most severely with 28 and 31 per cent respectively of these leaving the herds each year. Only 23, 25, 27, and 26 per cent left the four, five, six, and seven year old groups. Those eight or more years of age showed an increase in percentage culled ranging from 32 to 100 per cent.

The spread between the production of the non-culls and culls was compared for the various age groups in order to obtain evidence of when the most culling took place. When considered on this basis culling for production among younger cows was the most pronounced for the three year olds who

showed a spread between culls and non-culls of 75 pounds of butterfat. The two year olds had a difference of 63 pounds, while those from four to twelve years of age had a narrower spread, ranging from 32 to 60 pounds of butterfat. The milk production differences between the groups showed a similar trend.

Life expectancy estimates in terms of time cows will stay in C.T.A. herds have been computed for cows from two to seventeen years of age inclusive. In their computation, the number of animals falling into the various age groups at the beginning of each cow testing association year was used. The number present for a given age compared to the total cows represented in older groups was used as a basis for estimating their life expectancy. The data for the five years were combined to smooth out irregularities noted for individual years. In the resulting table the three year olds had the longest life expectancy in herds. The four, five, and two year old groups followed in order named. A rather slow decline was noted in the life expectancy up to nine years of age, with a rapid decline thereafter.

P41. The Breeding Efficiency of Proved (Aged) Sires. J. R. DAWSON, Bureau of Dairy Industry, U. S. Department of Agriculture.

A study was made of the breeding efficiency of 20 proved sires used in eight branch experiment station herds maintained by the Bureau of Dairy Industry. The sires included 8 Jerseys, 2 Guernseys, and 10 Holsteins, and only services and conceptions after the sires were 5 years of age were included.

Fertility is expressed by the percentage of the services to fertile cows that resulted in conceptions. The effect of extra services and services to unfertile cows is considered separately. A total of 3,585 services were included in the study, of which 2,982 were to fertile cows. The data were tabulated and analyzed from the standpoint of (1) the relative fertility of the individual sires, (2) the effect of advancing age on fertility, (3) the effect of frequency of service on fertility, (4) the effect of season of the year and climatic conditions on fertility, and (5) the effect of moving sires on fertility.

Seventeen of the 20 sires averaged 4 years and 5 months of fertile service in the herds after they were 5 years old. The shortest period of fertile service was 1 year and 7 months, while the longest period of fertile service was 11 years and 1 month.

Forty per cent of the 2,982 services to fertile cows resulted in 1,197 conceptions, which is a ratio of 2.49 services.

Great variation in fertility was exhibited by individual sires as evidenced by a low fertility of 21 per cent by one sire and a high fertility of 71 per cent by another sire.

There was a decided but inconsistent decline in fertility of the sires as age advanced. At 5 to 7 years of age, the average fertility of the sires was

52 per cent and at 13 years of age or over it was 28 per cent. There was wide variation between individual sires.

On the average there was a decided trend toward lower fertility as the number of services per month increased, but the effect of the frequency of service in one month was most pronounced in the following month. When no services per month were permitted, the average fertility was 47 per cent the following month. When from 1 to 3 services per month were permitted the fertility for the following month dropped to 45 per cent, with a further consistent decline to 30 per cent when 10 or more services were permitted for the preceding month.

Season of the year apparently had little if any effect on fertility. Grouping the data from the standpoint of climatic conditions showed that the fertility was only 36 per cent for the sires used at the southern stations, whereas it was 49 per cent for the sires used at the western and northern stations.

Seventeen of the 20 sires averaged 41 per cent in fertility during the first 3 months following shipment to their respective stations and only 32 per cent after they had been at the stations 10 to 12 months. There was a general increase in average fertility until it reached a high of 47 per cent after 19 to 21 months at the station.

Because of the extreme and inconsistent variation in fertility exhibited by the individual sires on all phases included in this study, it is apparent that averages are of little value for application to individual sires.

P42. Twelve Years with 1200 Cows. J. D. Bragg, Agricultural Supervisor, Department of Public Welfare, State of Ohio.

The Ohio Department of Public Welfare has the problems of housing, feeding, and clothing 36,000 state wards. These people must be guided morally and mentally while under its care in the twenty-three state institutions. Occupational therapy now furnishes numerous advantages to those who necessarily must be placed in the confines of the Ohio Welfare Institutions. The Welfare Department owns approximately 20,000 acres of land and cultivates about 12,000 acres in conjunction with the institutions. The dairy cow has become increasingly important to the members of the welfare family. She furnishes interesting and productive employment and a variety of wholesome and nutritious foods. The farming program is adjusted as nearly as possible to the needs of the dairy herds.

Twenty-seven hundred head of Holstein cattle located on sixteen farms furnish the bulk of the dairy products consumed and reproduce in surplus all of the heifers and bulls for replacements and for new herds. They give to those who care for them the pleasing task of working with something alive. These cattle have been responsive to kind treatment, careful feeding, selective breeding, sanitary housing, and sound health practices. As evidence, the herd average of more than twelve hundred cows has increased 49% in the last twelve years.

P43. Artificial Insemination of Dairy Cattle. C. L. Cole, University of Minnesota.

This experiment is being conducted in an attempt to test the practicability of artificial insemination in dairy herds under ordinary farm conditions.

The bull is kept at the North Central Station of the University of Minnesota and cows located from one to ten miles distant and in seven different herds are being artificially inseminated.

One herd of eighteen cows has had a very low breeding efficiency for the past several years and shows a rather low percentage for artificial insemination. It is, however, no lower than in previous years with natural breeding.

Another herd of twenty-three cows in which there has been continued trouble for several years with Bang's disease shows a very good breeding efficiency although it is impossible to make any comparison of records due to the 100% turnover of individuals during the past two years.

A third herd of forty that is disease free and on which complete breeding records have been kept for several years show a breeding efficiency considerably higher with artificial insemination than the preceding five year average.

The balance of the cows are located in small herds and their breeding histories are not available.

Sperm samples are collected by massaging the ampullae.

All the cows have been inseminated with fresh samples. The maximum age of any sperm used has not exceeded five hours.

The inseminating pipette is a glass tube about seventeen inches long. ¼ inch outside diameter with a 1/16 inch bore. This is welded at right angles to a tube about five inches long with a 3/16 inch bore. It is advantageous to have a pocket blown in this piece to serve as a receptacle for the semen. A pyrex glass speculum 1¼ inches in diameter and fourteen inches long and a flashlight complete the equipment.

The speculum is used to locate the cervix and a small quantity of semen is placed in the opening.

From available data, it seems that cows are best bred at the end of oestrum. We have made an effect to inseminate the majority at that time. Many of them have been inseminated from six to twenty-four hours after the passing oestrum with equally good results. Our data seems to indicate that better results will be obtained when cows are bred shortly after passing off heat than when bred at the first signs. Our data is not, however, complete or conclusive.

Three cows that had been both bred and inseminated several times and had failed to conceive were finally settled when small corpora lutea were removed from their ovaries during one oestrum and bred on the following oestrum. Another cow after failing to conceive was finally settled by rupturing the follicle mechanically and then inseminating her.

Extremely cold weather offers some obstacle since sudden chilling has a deleterious effect on the sperm.

Results seem to indicate that breeding efficiency can be maintained and often times improved by artificial insemination and that this method of breeding may offer an excellent opportunity to prove sires and greatly extend the use of already proven sires.

P44. Relation Between Rate of Growth and Milk and Fat Production.

H. P. Davis and E. L. Willett, University of Nebraska.

There is an urgent need of means of predicting producing ability in dairy cows before a lactation has been completed. Prentice, in unpublished data, has indicated a correlation between feed consumption of calves and subsequent milk and fat production. Turner, in unpublished data, has hinted at a close correlation between pituitary activity and production. Seventy-six closely related Holstein femals from the University of Nebraska herd were studied in rgard to their rate of growth between birth and two years as correlated with their subsequent milk and fat production for the first and for their lifetime average of lactations corrected to 365 days, class B, maturity. The three measurements were weight, height at withers, and chest girth. The 76 females were compared to the standards established at the University of Nebraska and found to compare closely with them.

The group of 76 females were arranged according to percentage of increase in weight at two years over birth, in groups with 50 per cent class intervals, varying from 900–949.9 to 1750–1799.99, with an average of 1220.6 This latter figure represents the relationship between 87 pounds at birth and 1149 pounds at two years of age. The subsequent production for the first and lifetime lactations of each group is presented in a table. The same animals were arranged according to percentage increase in height at withers by two percent class intervals and ranged from 70–71.9 to 100–101.9 with production for these gains shown on the table. The same animals were also arranged according to percentage increase in chest girth by four per cent class intervals, ranging from 120–123.9 to 172–175.9.

Seventy-six Holstein femals of the University of Nebraska herd, apparently normal according to standards established there, when their milk and fat records for the first and for the average of their lifetime lactations were arranged in tables according to the percentage rate of gain in weight, percentage increase in height at withers and percentage increase in chest girth, showed no significant relationship between rate of growth and production.

EXTENSION SECTION

E1. Methods of Presenting Different Extension Practices in the Testing Project. GLEN W. VERGERONT, Wisconsin College of Agriculture.

I. THE PROBLEM. LET US TAKE INVENTORY.
- A. Our project meets with considerable competition with others for the time of the county agricultural agent.
- B. Too many dairy herds have a level of production far below the line of profit.
  1. A study of butterfat sales by one county agent indicated a variety of incomes from dairy products at the same milk plants.
  2. THE COUNTY AGENT became interested in herd improvement.
- C. Methods used to interest his dairymen.
  1. A comparison of the average fat production per cow of the county, the state and the nation.
  2. New D.H.I. Association members were encouraged to estimate production expected from each cow in herd.
  3. Reasons for low producing herds.
- D: COUNTY-WIDE PLANS for dairy herd improvement.
  1. Plan to increase the net income for the dairy farmer.
  2. D.H.I.A. testing is a good dairy farm management practice.

II. Promotion.
- A. General publicity arousing a desire for herd improvement.
- B. Newspaper publicity prepared in cooperation with college agricultural journalism department.
- C. Schools.
  1. Breeding schools put on by the college men.
  2. Assistance at schools put on by breed associations.
- D. Tours, Cattle Exhibits, Picnics, 4H demonstration and judging contests.

III. Maintenance. The responsibility for maintenance for associations rests with the extension dairymen and the county agricultural agent.

IV. SUPERVISION AND INSPECTION.
- A. Farm visits to officers and members.
- B. Inspection and assistance to fieldman.
- C. District conferences.

E3. An Extension Program Coordinating Dairying, Crops, Farm Engineering, Farm Management and Forestry. A. R. MERRILL, Connecticut State College.

An Extension program must be practical for the section where it is to be

used. The reasons for this program must be sound and the results obtained must tend towards making for a stabilized agriculture.

The day of individual program making is past. No one specialist is important unto himself alone. No Extension program should be put out until it has had careful study by all specialists who may in any way be associated with its development. Individual subject matter should be handled only by the specialist who is directly informed on that subject, but all subject matter should fit into the general plan and be sound in practice.

Such studies will result in better programs and will educate both specialist and farmer toward a more uniform understanding of our extension problems.

E4. A Method Used to Illustrate the Fact that Higher Producing Cows Make Larger Returns for Roughages. W. T. CRANDALL, Cornell University.

Some farms are best adapted to the growing of roughage crops for which there is normally no satisfactory direct cash market. Dairy cows are kept on many of these farms as a means of marketing these unsalable farm crops and returning cash for them. It is just as important for dairy farmers to be interested in keeping good cows that will pay well for the home grown feed, as it is for them to sell their milk to a satisfactory market.

In order to emphasize the relation of better producing cows to higher returns for roughages, any sufficiently large number of cows with dairy herd improvement association records is divided into four groups. The division is made on the basis of yearly butterfat production and the range of selection is as follows: Under 250 pounds, 250–349 pounds, 350–449 pounds, over 449 pounds. A chart that is built up step by step during the progress of a lecture is used to show for each group the gross income, the costs of production other than for feed, the cost of grain and the amount remaining to pay for the pasture, silage and hay consumed. In the final addition to the build-up chart the amounts returned by the various groups for each ton of hay equivalent consumed (hay plus $\frac{1}{3}$ silage) is shown. It is possible to make up this kind of material when complete yearly feed and production records are available on as few as 400 cows.

A discussion of the results obtained from a recent study of the records of 436 full time cows in one New York dairy herd improvement association will indicate the type of material that can be presented by this method. The average yearly butterfat production in pounds of each group was 210, 296, 387 and 477 respectively. The calculated costs other than feed, the grain cost and the charge for pasture were deducted from the gross income of each group and amount remaining was credited to the hay and silage consumed. The 210 pound group was credited with nothing for hay and silage, the 296 pound group with $42, the 387 pound group with $60 and the 477 pound group with $82. On the basis of hay equivalent actually consumed the

groups paid the following amounts per ton: the 210 pound group, $0.00; the 296 pound group, $12.03; the 387 pound group, $18.50; the 477 pound group, $24.00.

E5. An Extension Program in Grassland Farming. C. B. BENDER, N. J. Agricultural Experiment Station.

The interest in a program of this type is stimulated by the same methods that are used to sell many other extension programs.

As this program includes both intensive pasture management and molasses grass silage as fundamental parts, the attack will vary with the season of the year. It is not necessary to start the program at any particular time of the year, the only essential is that the leader of the program should be enthusiastic about it because of the end results.

If the program is to be initiated on a state wide basis in the winter, meetings should be held in the various dairy centers of the state. At this time through talks and lantern slides the methods of carrying out the work, experimental results and economic experiences are brought out.

If any dairymen in the state have put up grass silage, barn meetings may be held at their farms at which time the leader of the project can discuss methods and objectives of the program and the dairyman can furnish his own experiences showing the practical feeding results he has obtained.

These meetings are followed up by news stories in the local and state press, circular letters sent out by the county agents and farm journal articles bringing experimental facts to light and submitting results that have been accomplished on dairy farms within the state.

In the spring and summer months field meetings should be held on pastures to explain this method of grassland management. Again it is extremely advisable to have the owner give the results he has obtained by following this program.

Barn and field meetings should be held while the silos are being filled with molasses grass silage. The dairymen may then have an opportunity to study the harvesting methods and the methods of adding the preservative. At this time yield and cost data may be stressed to give comparisons with corn silage. Furthermore comparative acre yields of protein should be stressed between legumes, grasses and corn. Increased use of silos as well as silo capacity figures are of value at these meetings.

The fact should be stressed at every opportunity that this is a program of erosion control which can be carried out by a farmer without embracing contour farming or strip farming methods. Molasses preservation of legumes and grasses is excellent crop insurance because it eliminates the hay making losses due to inclement weather. The method provides a better labor distribution and any dairy farmer who has a silo, silage and hay machinery can carry out the program successfully and with sound feeding economy.

E6. A Method for Preventing Onion Flavor in Milk. C. E. WYLIE, University of Tennessee.

For over 150 years wild garlic or wild onions have gradually spread from the Atlantic coast to all sections of the country. While it affects several agricultural products it is becoming a serious menace to dairying in certain sections. It affects the milk and it is crowding out good pasture grasses. The methods which have been recognized for control of the onion problem are as follows: (1) Cultural methods, (2) Feeding methods, and (3) Removal of the flavor from milk or cream. Each of these methods has its peculiar advantages and adaptability.

PREVENTION BY MOWING PASTURES

It has been found that allyl sulphide in the onion tops is the cause of the onion flavor in milk. This unites with the butterfat. It is a volatile substance which passes off in the air when the tops are cut. The onions grow readily early in the spring ahead of other vegetation because a temperature of 30°–50° F. is favorable for their growth. The tops stop growing late in the spring.

In order to determine when to cut the tops, small plots, about eight feet square, are marked off for trial cuttings. A hoe is used to cut off the tops. If, on examination, a few days later, no new onions have come up it is time to mow the entire pasture with a mowing machine. When the onions are wilted, by the second day, cows may be pastured on such pasture for the summer season. This method is not satisfactory for handling the crop of onions which come up in the fall. Neither will this method eradicate the onion plant. This method of mowing pastures has been successfully used for more than ten years at the University of Tennessee in a pasture badly infested with onions.

E7. The Use of Electric Fence in Bull Pen Construction. JAS. W. LINN.

The customary bull pen is not adequate for the average breeder or dairyman.

In bull pen construction, the electric fence has its main value as a supplement to other fences and when properly installed with an efficient transformer, is safe and effective.

E8. Dairy Cattle Breeding Schools. E. E. HEIZER, Ohio State University.

The following outline presents subject matter covered in a two session breeding school. Film strips, motion pictures, charts and Herediscopes are utilized as methods of presentation.

FIRST SESSION

Principles of Heredity

(a) Biological Foundation.

The Cell—Ordinary cell division, formation of germ cells, control of sex.

(b) Theories of Inheritance.
Older Theories.
The contribution of Mendel.
One, two and three factor inheritance.
Multiple factor inheritance.

(c) Abnormal and lethal factors.

(d) Variation and Selection.

(e) Breeding Practices.
Crossbreeding, Outcrossing, Linebreeding and Inbreeding.

SECOND SESSION

The Requirements of a Constructive Breeding Program

1. Sound Health Program.
Only healthy, disease-free cows produce efficiently.
2. A Complete Testing Program.
Continuous testing of all cows in the herd.
(a) Importance of environmental influences on production.
3. Intelligent Use of Records.
(a) Cull inefficient cows.
(b) Measure hereditary constitution of sires and breeding cows.
(c) Interpretation of Proved Sire Records.
(d) "Nicking" or Heterosis demonstrated by sire analysis.
(e) Utilization of sires—cooperation, artificial breeding.
(f) Importance of life span on profitability of dairy cows.
(g) Cow Family Studies.
(h) Herd Analysis.
4. Young Sire Selection.
5. A Breeder's Ideal.

E13. Report of Quality Committee, Extension Section, American Dairy Science Association. C. J. BABCOCK, Chairman, Bureau of Dairy Industry, United States Department of Agriculture.

A questionnaire sent to each of the States and returned by 46 of them revealed the following: Approximately 15.2 percent of our dairy extension is related to quality-improvement work. If evenly distributed and based on properly outlined projects for improving the quality of milk and cream as delivered to the plant, this percentage would not be unduly out of proportion. However, at least one-half of this extension work deals with methods of manufacturing dairy products. This lowers the percentage of extension work related to farm conditions to less than 9 percent. Looking at it from another angle; the 46 States reporting had on an average 1.7 men

working on dairy production compared with not over 0.15 of a man reported as doing work related to sanitary milk production, a proportion better than 10 to 1 for production over quality. Although this ratio is entirely too low and does not balance the importance of quality and production, it is actually too favorable to quality improvement. The ratio is correct according to the figures given, but a study of the projects reported reveals a large percentage of time has been credited to quality improvement that has no direct relation to improving the quality of milk and cream as delivered to the plant.

The questionnaire plainly revealed that a great majority of our States do not have a well defined or well outlined project for improving the quality of milk and cream.

Many of the States measure the results of quality work by what may be termed hearsay evidence. They have no estabilshed base from which to measure results. Neither do they have definite means for such measurements. This is largely due, no doubt, to the fact that they do not have well defined programs.

If the extension service would assume the leadership in a quality-improvement project, it could easily obtain the cooperation of the various agencies within the State necessary for its success.

The new projects which are to be started during the next year are few in number and, as a whole, show but little promise of accomplishing definite results.

Although practically all of the States admitted that insufficient extension work was being done on quality improvement, practically nothing is being done by our extension services to remedy this condition.

E14. Progress Report of Quality Committee of Dairy Products of the Dairy Manufacturing Section of the American Dairy Science Association. W. H. E. Reid, Missouri Agricultural Experiment Station.

The quality of milk and milk products from the consumers point of view has received more than usual study during the past three years. Interest in this study has been manifested by our experiment stations and the different phases of the commercial industry. This interest includes all divisions of the dairy industry, production and manufacturing.

Consideration has been given to projects applicable on dairy farms and in dairy manufacturing plants which have for their objective improvement of methods practiced and equipment used in producing milk and the manufacture of dairy products which include butter, cheese, ice cream, condensed milk, evaporated milk and dry skimmilk. These projects are broad in their scope so as to be applicable in all states where milk production is of primary importance.

It is obvious that the objectives of quality programs projected by production and manufacturing interests are quite alike and should be coordinated in order to effect maximum accomplishments. Progress should be greatly facilitated by acquiring a mutual understanding of programs of the different interests involved.

E15. Milk Schools as a Means of Improving the Milk Supply. J. A. NELSON, Montana State College.

Regular milk samples are collected by the milk inspector unbeknown to the producer. The samples are scored in accordance with the U.S.D.A. score card B.D.I. 64. A meeting of all the producers is called at which time the dairy extension specialist discusses the factors that make for a good milk. Samples with defects in flavor are used for demonstration and the possible remedies explained. The milk samples are listed according to quality and at the end of each meeting the producers are confidentially given their scores with the defects and possible causes explained. This method is used not only for market milk but also for milk which is to be manufactured into other dairy products.

E18. What We Can Learn from Denmark in the Use of Artificial Insemination. E. J. PERRY, New Jersey Agricultural College.

A close range study of cooperative artificial breeding in Denmark has revealed its success. During the past 21 months, 1,200 cows owned by 220 cooperating Danish farmers were inseminated by using the semen of two sires. The work is being done by a salaried veterinarian. His primary job is insemination. The balance of his time is divided between preconception treatment and examination for pregnancy both of which are performed when his regular duty brings him to the farm or neighborhood. The plan puts breeding on a scientific basis and is of particular value to the rank and file of dairy farmers who cannot afford to pay similar services individually. Every sample of semen is examined under the microscope before it is used. To date the artificial method in Denmark has required an average of 1.2 services per conception whereas the natural method has required 1.8 services, or a difference of 33⅓ per cent. Other recognized advantages are: 1. The blood of superior sires can be widely utilized at a very low cost per service. 2. Practically eliminates the spread of disease through service. 3. Eliminates the necessity of keeping and feeding a bull on each farm. 4. A large family of cattle is quickly established in a district.

The technique of collecting, preserving and using the semen should soon become fairly well standardized. The artificial vagina as a means of collection is in favor in Denmark, the British Isles, Holland, Russia. It is of particular advantage before bulls have reached an old age. By it the semen can be gathered quickly and probably in a little cleaner condition than by

other methods. Collection by massaging the accessory genital organs, the system developed in this country, is of particular advantage when using older bulls. While all bulls do not respond equally well to this method and the quantity of semen obtained is sometimes small, it nevertheless is proving fairly satisfactory in cases where the proper technique of massage has been learned. In large scale artificial breeding it is recommended that both of these systems of collection be mastered so that either can be practiced, as the circumstances require.

In a well organized artificial breeding project, which does not operate over too large a district, the yearly cost per cow should not exceed $5.00. This figure is hardly as high as the yearly cost of bull service per cow in well managed herds where complete data including feed, labor, depreciation, housing and other items are included.

MANUFACTURING SECTION

M1. Some Factors Affecting the Estimation of Fat in Milk by the Babcock Method. W. A. CALDWELL AND E. O. HERREID, Vermont Agricultural Experiment Station.

Several Vermont Dairy Plants have shown, according to their books, excessive losses of butterfat; that is they have been unable to account for the fat purchased when checked against the fat sold in milk and milk products. These so-called losses caused so much concern that plant managers brought this problem to the dairy department at the University of Vermont for assistance.

To determine the amount of fat unaccounted for, the losses in one plant were summarized by months over a period of four years. The years 1932, 1933, and 1934 showed a greater amount of fat unaccounted for during the first as compared to the last six months of each year. The same relationship existed in 1935 but the difference was small. In two small receiving stations handling only milk and cream, the intake was checked with the outgoing fat. At plant A on three consecutive days the fat unaccounted for was 5.10, 6.25 and 3.75 per cent respectively and at plant B the results showed a loss of 4.52 and 6.79 per cent on two consecutive days.

In view of the fact that difficulties were experienced in accounting for fat under conditions existing in these dairy plants, it was deemed advisable to approach this problem through a study of some of the factors that might affect the estimation of fat by the Babcock method. The factors studied were temperature of sampling milk, temperature of adding water, temperature of water bath, temperature and speed of centrifuge, and effect of reading the tests with glymol. Mojonnier fat determinations were made on the same samples.

Milk was sampled at temperatures of 40, 70, 100 and 140° F., and the results showed that within the extremes of 40 to 140° F., the test was decreased

by 0.08 per cent as the temperature was increased. Within a range of 40 to 100° F. the test was decreased by 0.04 per cent.

The influence of temperature of centrifuge was studied at 75, 140 and 180° F. and ten samples of milk averaged 4.21, 4.23 and 4.24 per cents respectively. With respect to speed, the centrifuge was operated at 850, 1050 and 1400 R. P. M. and the results averaged 3.94, 3.95 and 3.99 per cents respectively.

The temperatures of water bath studied were 100, 140 and 160° F. The average results were 4.33, 4.37 and 4.40 per cents respectively.

The last 980 tests made in the above experiments were read with and without glymol and the results showed that glymol reduced the average test by 0.165 per cent. Sixty samples of milk were tested in quadruplicate by the Babcock method and in duplicate by the Mojonnier method. The former were read from the bottom of the lower meniscus to the extreme top of the upper meniscus and by eliminating the upper meniscus with glymol. The average readings obtained were as follows: Mojonnier, 3.84 per cent; Babcock, read without glymol, 4.00 per cent and the Babcock read with glymol, 3.83 per cent.

All Babcock tests made in this study were run according to Vermont regulations and in addition a column-meter and a magnifying glass were used to read the tests to the nearest 0.05 and nearest 0.1 per cent. The results reported are for fresh milk.

M2. The Cause and Prevention of the Decrease in Fat Test of Composite Samples. R. F. HOLLAND, Cornell University.

It has been known since 1890 that the Babcock tests made on composite fall about 0.1 per cent below the average as determined by daily tests on fresh milk.

The decline in test is most rapid during the first few days of storage and is greater when the samples are stored in composite sample bottles than when pipetted and stored in Babcock test bottles. The decline in test takes place when either the Mojonnier or the Babcock method of fat estimation is used.

The factors responsible for faulty dispersion of the fat such as "oiling off," churning, and packing of fat globules contribute most to the decline.

Saponin prevents the decline in test and can be used in samples to be tested by either the Babcock or Mojonnier methods. Five-tenths of a gram is sufficient for a 250 ml. sample.

Saponin reduces the danger of churning samples when preparing them for the test, and permits dispersion of the fat without the necessity of heating the sample.

M3. A Study of the Resazurin Test as Applied to Cream. HERBERT JENKINS, New England Dairies, Inc., Boston, Mass.

Shortly after the publication of Ramsdell, Johnson and Evans' report on resazurin as an indicator of the sanitary condition of milk, experimental work was started in these laboratories to determine whether or not resazurin could be used for the same purpose with pasteurized cream.

The research program was threefold: first, to ascertain the proper concentration of resazurin dye to use; second, to set a standard on the basis of reduction time for good, fair, and poor quality cream; third, to find out of the resazurin test would be a more rapid indicator of the quality of cream than the Methylene Blue Test. More than four thousand samples of cream of varying quality were used in this study which covered an entire year. Comparisons were made with the following tests: resazurin, methylene blue, microscopic, standard plate, and acidity.

It was found that one-tenth of one cc of .05 per cent resazurin dye solution is the proper amount to use with ten cc of cream. Procedure is then the same as for the Methylene Blue Test. The cream-resazurin mixture is grey in color and reduction time is recorded when the grey turns to pink. Creams reducing in less than one hour were generally found to have poor keeping qualities and had bacteria counts above 300,000 per cc. Creams which did not reduce in less than two hours had bacteria counts below 100,000 per cc. If pasteurized cream did not reduce within three hours with the resazurin test, it could be relied upon to have good keeping quality and to have a low bacteria count. A two-hour incubation period with the resazurin test gives results comparable to five hours with the Methylene Blue Test. Cream which reduced resazurin in five to fifteen minutes takes from one to one and one-half hours to reduce methylene blue. Results indicate that the resazurin test is a practical test for determining the bacterial quality of pasteurized cream and is superior to the Methylene Blue Test in that results are obtained more rapidly.

M4. Studies of Lipase Action in Milk. VLADIMIR N. KRUKOVSKY AND B. L. HERRINGTON, Cornell University.

The extent of lipolysis of the fat in milk was determined by titrating the free fatty acids in butter-oil prepared from the milk. It was possible to show that lipolysis occurs in normal mixed milk between the time of milking and the time of delivery at the pasteurizing plant.

A study of the milk of individual cows indicated the presence of active lipase in practically all samples, though there is considerable individual variation.

A study of commercial pasteurized milk sold in the State of New York revealed much larger quantities of free fatty acids than are normally present in fresh milk.

By warming cold raw milk to approximately 30° C., and then cooling slowly, the subsequent rate of lipolysis was greatly increased.

Evidence was obtained showing that milk contains at least two lipases. One is very sensitive to formaldehyde. The other is quite resistant to it. The relative amounts of these two enzymes varies in different samples of milk.

M5. Observations on the Lipase Activity in Cow's Milk. J. C. PFEFFER, H. C. JACKSON AND K. G. WECKEL, University of Wisconsin.

This investigation deals with a study of the lipase activity of cow's milk. The method of Nair was employed in all experiments to determine the lipase activity.

The authors found that no direct correlation existed between milk of late lactation and lipase activity. A direct relationship, however, was found between the amount of milk produced and such activity. Less lipolytic activity was observed when the milkings were ten pounds or less than when the milkings exceeded fifteen pounds.

The lipase activity of the milk from an individual cow does not vary to any great extent from day to day.

A marked decrease in lipase activity of milk was observed when cows are taken from pasture and placed on dry feed. This decrease in activity is not permanent, as it returns to normal within two weeks. A similar decrease is observed when cows are changed from dry feed to pasture.

The lipolytic factor is carried in the serum of the milk. When milk is separated, greater lipolytic activity is observed in the skimmilk than in the cream. As the fat content of the cream is increased the lipolytic activity decreases.

An increase in temperature of the milk during separation causes a decrease of lipase activity of both the skimmilk and cream. A marked decrease occurs when the milk is separated at 120° F. The slime of the separator bowl is an excellent source of lipase and possesses approximately three times the lipolytic activity of the original milk. The decreased activity resulting from higher temperatures of separation is believed due to inhibition of the enzyme by heat. Since the inhibition is approximately the same in cream, skimmilk and separator slime, it appears the effect of higher temperatures of separation is due to inactivation rather than fractionation of the enzyme.

The increased activity of lipase after homogenization of raw milk is not due entirely to decrease in fat globule size. A very slight difference is observed when untreated milk is added to homogenized and unhomogenized substrates.

Salt has an inhibiting effect on the enzyme. Salted raw cream butter develops less acidity than raw unsalted butter.

M6. Detecting Milk that May Become Oxidized. GEORGE R. GREENBANK, Bureau of Dairy Industry, U. S. D. A.

A simple method of determining the susceptibility of milk to oxidized flavor has been developed. A small amount of copper sulfate is added to the milk and the increase in oxidation-reduction potential determined. Unusual increases in potential indicate samples that may become oxidized. From 3 to 6 hours are required to complete the test. On samples of known origin and treatment the test has been at least 90 per cent reliable.

M7. The Relation of Oxidation-Reduction Potential to Oxidized Flavor in Milk. GEORGE R. GREENBANK, Bureau of Dairy Industry, U. S. D. A.

A study was made of the nature of the oxidized flavor and its relation to the oxidation-reduction potential of the milk.

The conclusions are based on examination of more than 3,000 samples of milk from many cows.

Thermal inhibition of the flavor is shown to act through a lowering of the oxidation-reduction potential.

The effect of metallic contamination on the flavor is shown to vary with the metal and its physico-chemical state.

Inhibition of the flavor by a change from dry to green feed is paralleled by a decrease in oxidation-reduction potential and an increase in poising action.

Light may inhibit, promote, or have no effect on the development of the flavor, depending on contamination and intensity of irradiation.

A schematic equation is presented which indicates the nature of the oxidation. A theory in keeping with the observations made during this study is presented to describe the nature of the oxidation. The equation assumes a mild chemical oxidation.

Many isolated facts presented by other workers are explained by means of oxidation-reduction potential changes.

M8. A Study of the Relation of Titratable Acidity to Metal-Developed Oxidized Flavor in Milk. W. CARSON BROWN AND R. B. DUSTMAN, West Virginia Experiment Station.

At the West Virginia Experiment Station a study of the acidity of 220 individual samples of freshly drawn cow's milk has shown no apparent correlation between the natural acidity of the milk and its tendency to develop oxidized flavor when contaminated with copper. All experiments in which acidity was studied were carried out on pasteurized winter milk and the tendency to develop oxidized flavor was determined by the addition of 1.3 p.p.m. of copper added after pasteurization, followed by a three-day storage period of 35° to 40° F. The presence of oxidized flavor was determined by taste.

Anderson, Dowd, and Stuewer (1937) found that the titratable acidity of winter milk is higher than that of summer milk. Since this seasonal change occurs coincidental with the change of susceptibility of milk to oxidized flavor, it seemed possible that this condition may have been partially responsible for oxidized flavor. Anderson and his co-workers found an association between acidity and the tendency to develop oxidized flavor and that "milk of high acidity invariably developed an oxidized flavor upon pasteurization." However, at West Virginia, the analysis of the data obtained from 220 individual cows' samples did not show any difference in the apparent acidity of the milk from cows whose milks were susceptible to oxidized flavor and those whose milks were free from this defect.

Anderson and co-workers were able to eliminate oxidized flavor from a commercial milk supply by reducing the titratable acidity to 0.145 per cent. However, in the present study neutralization to 0.13 per cent titratable acidity, or in a small number of cases to 0.10 per cent, did not effect the development of the flavor.

No explanation is offered for the discrepancy in results which have occurred except that possibly the milk used by Anderson and his co-workers was subject to the development of oxidized flavor without copper contamination while the milk used in these trials would not develop oxidized flavor unless contaminated with copper. It is also possible that in their work, because of neutralization, the milk did not dissolve sufficient copper from the equipment to cause the flavor to develop. In all trials herein reported the copper was added after pasteurization in the form of a copper sulphate solution. In view of these facts it would have been desirable to have made several trials upon naturally susceptible milk, but during the past two years milk of this type has not been available, except in rare cases, in the University herd.

The results of these experiments indicate that metal-developed oxidized flavor is not related to the acidity of freshly drawn milk and that the standardization of the titratable acidity to 0.13 per cent does not decrease the tendency of oxidized flavor to develop.

M9. Studies on the Activated Flavor of Milk. J. C. Flake, H. C. Jackson and K. G. Weckel, University of Wisconsin.

The specific flavor defect which is sometimes apparent in over-irradiated commercial vitamin D milk, and known as activated flavor may best be described by the terms burnt protein or burnt feathers. The terms mushroom and sunshine flavor are sometimes used. The flavor is greatly intensified by heating the irradiated milk to 180° F. or higher.

Studies were instigated to determine the conditions under which the flavor develops and something of the chemical characteristics of the compound responsible for the flavor.

It was found that when milk was heated to temperatures above 150° to 160° F. and cooled, previous to irradiation, the resulting irradiated milk had a more intense flavor than when either raw or ordinary pasteurized milk was irradiated.

Attempts at altering the salt balance of the milk by addition of sodium citrate, di-sodium phosphate, calcium acetate, calcium chloride, calcium lactate, or di-basic calcium phosphate failed to increase or decrease the flavor intensity.

It was found possible to remove the activated flavor from milk by oxidation. The addition of a small amount of either hydrogen or calcium peroxide either before or after irradiation caused a marked decrease in intensity of flavor. It was possible to remove the flavor by adding two to three parts per million of copper to the irradiated milk followed by bubbling air through the milk either at room or higher temperature. The best results with this method were secured by holding the milk at 140–145° F. for 30 minutes and bubbling air through it during this interval. Oxidized flavor eventually developed in the milk given this second treatment, when it was cooled and held at 40° F., but only after 36 to 48 hours. However, irradiated milk whether given this treatment or handed normally shows no greater tendency for development of oxidized flavor than does normal milk.

The studies indicated that when irradiation and homogenization are both used in processing milk better results are secured if irradiation preceeds homogenization.

M10. Variation in the Composition of Milk and the Effect on Solids-not-Fat. H. A. HERMAN, University of Missouri.*

Variations in the fat and solids-not-fat content of milk are often the contributing factors for controversies, many times of legal nature, in the selling and buying of milk. In an effort to gain additional information concerning the extent and nature of these variations the milk produced by the Missouri Station herd is being analyzed daily for fat and total solids content. In addition the milk from 25 cows is being analyzed every other week for total nitrogen, lactose, and chlorides. The effects of feeding, stage of lactation, season and temperature, age of the cow, and under soundness on the composition of the milk are included as a part of this study.

The data gathered to date indicate that season or temperature, it being very difficult to separate these two factors under practical conditions, largely accounts for the decline in the solids-not-fat content of the milk produced during the summer months.

In the herd of 60 cows, made up of 49 percent Holsteins, 39 percent Jerseys, and 12 percent Guernseys, the solids-not-fat content of mixed herd milk

* Contribution from the Department of Dairy Husbandry, Missouri Agr. Exp. Sta., Journal Series No. 563.

for the past twelve months has been observed to range from 8.0 to 9.7 percent. During July, August, and September of 1937, however, the range was from 8.1 to 8.7 percent, with an average solids-not-fat value of 8.45 percent. The majority of samples were above the legal standard of 8.25 percent solids-not-fat, but during July and August in particular, nearly 50 percent of the samples gave readings below 8.5 percent, the standard set by some cities. The temperature during these two months was seldom above 95° F., and was hardly comparable to the drought years of 1934–35–36 when the mercury often reached 110° F. The cows were fed largely on hay, silage, and grain, with limited blue grass pasture.

Turning the cows on succulent barley pasture in April and May resulted in an increased milk yield, but so far as can be determined the solids-not-fat content of the milk was not affected, averaging 8.4 to 9.5 percent for this period. Analyses of the milk produced during the summer months, when the solids-not-fat was lowest, showed the lactose and totals nitrogen to be lower than previous, and the chloride content increased. During the fall and winter months the total nitrogen and lactose increased. The chloride content of the milk increased gradually throughout the lactation period.

The solids-not-fat content of the milk of individual cows was found to be high immediately following freshening, but to decline during the height of milk flow, and increase as lactation progresses. The lactose content of the milk decreased quite markedly near the end of lactation and the total nitrogen and chloride content increased. The increase in chloride content near the end of lactation is quite sharp and it seems apparent that the osmotic pressure of the milk is maintained at this period by the substitution of ionized chloride for lactose.

M11. Studies on the Mold Mycelia Content of Sour Cream Butter. J. ADAMS AND E. H. PARFITT, Purdue University.

Examinations have been made on commercial samples of butter manufactured between August 1 and April 1, using the technique suggested by Wildman for the examination of mold mycelia in butter. In addition, controlled samples have been prepared to determine factors influencing the amount of mycelia in butter.

A definite seasonal trend was found in the mycelia content of commercial butter, being highest during the summer months and lowest during the winter months. In a study involving 205 samples of commercial butter made during December and January, 99 per cent of the 103 samples which were graded as first grade had mycelia counts of less than 40 per cent positive fields, and 41.1 per cent of the 102 samples which were second grade had mycelia counts of less than 40 per cent positive fields.

The retention of mold mycelia in butter was found to vary from 30 to 60 per cent of the total mold content of the cream and such factors as wash-

ing, working of the butter, and pH of cream at the time of churning had no appreciable effect upon the amount of mold mycelia retained in the butter. Factors influencing the growth of mold in cream such as age, incubation temperature, amount of cream surface exposed to air, and agitation of cream during holding have been studied and found to affect mold mycelia count of the butter. A method has been developed using a fat solvent for determining the mold mycelia in cream.

M12. The Effect of Temperature Upon Score Value and Physical Structure of Butter. W. H. E. Reid and W. S. Arbuckle, University of Missouri.*

Recent studies reveal that temperature is an important factor influencing the flavor of various dairy products. Submerged flavors exist at lower serving temperatures of the product, while full pronounced flavors are manifested at high serving temperatures.

When samples of butter were scored at temperatures of 40, 50, 60 and 70 degrees Fahrenheit, those samples at 50 degrees Fahrenheit received .5 to 2.5 points lower flavor score than at other temperatures. This procedure serves as a means of determining the quality of the cream used, efficiency of plant methods and the treatment butter receives subsequent to manufacture. It was observed that as the temperature of the butter was increased, flavors that are normally submerged at lower temperatures become apparent. The flavor score of butter manufactured from high quality cream was enhanced as the temperatures were raised, whereas the flavor score of butter made from cream of a questionable quality declined with increased temperatures.

Graphs showing rise in temperature of cubes, quarter and one pound prints of butter exposed at 80 degrees Fahrenheit indicated rapid temperature increase in the cubes, while a much slower rise was shown in quarter and pound prints.

A comparison of the structure and body consistency of the butters at different temperatures is being made by the use of the microscope.

M13. Application of the Burri Smear Culture Technic to the Examination of Butter. H. F. Long and B. W. Hammer, Iowa Agricultural Experiment Station.

The Burri smear culture technic can be used to examine butter by picking small portions with a platinum needle, and culturing each on the surface of a dry agar slope. After incubation the colonies on the slopes are counted and studied for colony types. The maximum number of colonies on a slope that can be counted readily is about 100 although larger numbers can often

* Contribution from the Department of Dairy Husbandry, Missouri Agr. Exp. Sta., Journal Series No. 556.

be estimated satisfactorily. Various media and incubation conditions can be used with the procedure. If a differential medium, such as one containing milk and fat for the detection of proteolytic and lipolytic organisms, respectively, is employed, it can be poured into a plate and each portion of the butter smeared over a segment of the plate.

Many normal and abnormal samples of both commercial and experimental butter have been examined with the technic, using beef infusion agar and an incubation of 4 or 5 days at 21° C; the portions of butter were picked under a low power binocular to keep the size as uniform as possible and averaged approximately 1/20,000 of a gram.

The results indicate that the distribution of bacteria in butter, as regards both numbers and colony types, is often highly irregular. Such a distribution emphasizes that the growth of bacteria in butter is largely limited to certain points, presumably infected moisture droplets. It may be influenced not only by the original contamination of the butter but also by other factors such as irregularites in salt distribution, etc. The plate method gives no information on the distribution of organisms in butter because of the size of the sample taken and mixing of the organisms in it during plating.

The Burri technic often gives lower total counts than the plate method, due probably to the failure to break up clumps of bacteria and to overcrowding on slopes; with heavily seeded slopes it is difficult to distinguish the individual colonies and some organisms may even fail to grow.

Since all of the colonies developing on the slopes are at the surface of the agar, a better differentiation into colony types is obtained with Burri technic than with plates in which some colonies are subsurface. Occasionally, colony types have been noted on Burri slopes which did not grow on plates or which were diluted out in the plates suitable for examination.

M14. The Application of the Phosphatase Test to the Butter Industry.
W. H. Brown, E. H. Parfitt, Purdue University.

The phosphatase test as it is used for milk has been applied to butter to determine whether or not the cream has been properly pasteurizd prior to churning. The Scharer technique, with one ml. of butter serum used to replace the one ml. of milk as the directions indicate, has been followed. The butter serum is collected by centrifuging the sample of melted butter.

The application of the phosphatase test on the butter serum has shown:

That of 372 samples of commercial butter analyzed, 31.2 per cent gave a positive phosphatase test. A larger percentage of the samples that gave a positive phosphatase test, when subjected to the keeping quality test of 15.4° C. for 10 days, dropped in score more than did those that gave a negative phosphatase test.

The butter serum tended to give a more positive reaction than did the corresponding cream and there exists the possibility of the manufacturing process of the butter influencing the phosphatase reaction.

M15. Preliminary Studies of the Neutralization of Cream for Buttermaking. R. C. TOWNLEY AND I. A. GOULD, Michigan State College.

In an effort to determine the efficiency of various neutralizers for sour cream and to ascertain the accuracy with which they reduce the acidity of the cream to different calculated acidity ranges, seven neutralizing agents were studied. These neutralizers were sodium carbonate, sodium bicarbonate, a mixed sodium carbonate-sodium bicarbonate neutralizer, a newly recommended commercial product which on the basis of analysis is apparently composed chiefly of sodium and potassium carbonates, sodium hydroxide, magnesium lime, and calcium hydrate.

The original titratable acidity of the cream used throughout this study was approximately 0.5 per cent, expressed as lactic acid. This cream showed a pH of about 4.7 and a fat content of 30 to 35 per cent. The neutralizing factors used were those submitted by the manufacturers for the commercial products, or, in the case of the other products, were those which were found to be correct by the neutralization of lactic acid. The additions of the neutralizers were made on the basis of calculations to reduce the acidity of the cream to the following percentages: 0.25, 0.15, 0.10, and 0.05.

The preliminary findings indicate wide variations in the efficiency of acid reduction by these neutralizers. In general, the carbonate neutralizers failed to reduce the acidity to the calculated point with the reduction being only slightly in error at 0.25 per cent, but being more widely in error when efforts were made to reduce the acidity to a lower range. The ranges of the values secured by the different carbonate neutralizers which correspond to the theoretically expected acidities of 0.25, 0.15, 0.10, and 0.05 per cent, were 0.26 to 0.29 per cent, 0.19 to 0.23 per cent, 0.145 to 0.18 per cent, and 0.13 to 0.165 per cent, respectively.

The limes gave more accurate reductions than the carbonates throughout the acid range studied, with the values being close to those theoretically expected at acidities of 0.25 per cent and 0.15 per cent, but tending to be somewhat higher at the lower acidities. The caustic soda gave the most accurate reduction of any of the neutralizers studied with the values corresponding to 0.25, 0.15, 0.10, and 0.05 per cent, being approximately 0.23, 0.15, 0.11, and 0.075 per cent.

The pH determinations, made before and following the processing, showed variations to occur when different neutralizers were used. When the neutralizers were added at a rate calculated to reduce the acidity of the cream to 0.05 per cent, the average pH values of the cream were as follows: sodium carbonate, pH 6.7; sodium bicarbonate, pH 6.82; mixed soda neutralizer, pH 7.13; mixed sodium and potassium carbonate neutralizer, pH 6.82; sodium hydroxide, pH 7.42; magnesium lime, pH 7.16; and calcium hydrate, pH 7.01.

M16. The Relation of Milk Quality to Grade of Swiss Cheese. L. A. ROGERS, ROBERT E. HARDELL, AND FRED FEUTZ, Bureau of Dairy Industry, U. S. D. A., in cooperation with the Ohio State University and the University of Wisconsin.

While it is generally conceded that milk of low bacterial content is required for making Swiss cheese, no exact data have been available.

Data collected in 1936 and 1937, representing over 400 cheeses made in 20 factories in Ohio and Wisconsin, show that, in general, the number of first-grade cheeses increases directly with the quality of the milk as measured by the methylen-blue test. The effect of the bacteriological condition of the milk is also evident in the development of acid during the making process, which in turn has a definite relation to the grade of the cheese. If the milk is deficient in lactic bacteria so that the pH at dipping is not lower than 6.50 the chances are three to one that the cheese will be undergrade. If there are too many acid-forming bacteria capable of growing at the high temperatures maintained in the kettle and the pH at dipping is below 6.40, the chances of making a first-grade cheese are less than even. If the milk reduces methylene blue in less than 3 hours and the pH at dipping is less than 6.40 the chance of making a first-grade cheese is about one in three. If the methylene-blue reduction time is over 3 hours and the pH at dipping is between 6.40 and 6.50 the chances that the cheese will be first grade are about three in four.

M17. Clarification of Milk for the Manufacture of Swiss Cheese, with Special Reference to the Use of Mastitis Milk. KENNETH J. MATHESON, GEORGE P. SANDERS, LLOYD A. BURKEY, AND J. FRANK CONE, Bureau of Dairy Industry, U. S. Department of Agriculture.

Data are presented dealing with the causes for the differences that exist between clarified and unclarified milk, together with the demonstrated value of clarifying mastitis milk used in the manufacture of Swiss cheese. The conclusions are as follows:

There is definitely more oxygen in clarified than in unclarified milk. Oxygen in milk may influence the set of the resulting cheese.

Clarification promotes the efficiency of the Swiss-cheese cultures as determined by pH measurements.

Both unripened and ripened unclarified-milk cheese contains more water than the clarified-milk cheese. Penetrometer readings indicate that the unclarified-milk cheese is softer in texture than the clarified-milk cheese.

The set of the cheese is increased with low as compared to high speed clarification and where low instead of high clarifying temperatures are used for the milk. The set of the cheese is increased, as compared to suitable checks, when the removed slime is returned to clarified milks, and when unclarified gravity cream is employed as a source of fat.

There is a correlation between the set of the cheese and the fat clusters. As the number of fat clusters is reduced the set of the cheese is improved.

Clarified-milk cheese usually contains slightly less lactose at 21 hours than unclarified-milk cheese.

The set of clarified-milk cheese is increased with an increase of the water content. It is also increased when there is an increase of the pH value at 21 hours.

With clarified mastitis milk the number of leucocytes is reduced about two-thirds as compared to the unclarified milk; and the rate of acid development is more rapid at the 8-hour period in the cheese.

The set of the cheese is increased as the number of leucocytes increases.

In 22 comparisons of clarified with unclarified mastitis milk the grades of the cheese were as follows:

Clarified mastitis milk cheese: Fancy, 4.54 per cent; Specials, 22.72 per cent; No. 1, 68.18 per cent; and No. 2, 4.54 per cent.

Unclarified mastitis milk cheese: Special, 9.09 per cent; No. 2, 90.90 per cent.

Clarification of mastitis milk is capable of causing the cheese made from such milk to be a Special, a No. 1, and even a Fancy, instead of a pin-eyed nissler.

There was only 1 typical pin-eyed nissler in the clarified-milk cheese, while there were 17 of this type in the unclarified-milk cheese.

It is to be understood that this question has been attacked solely as a research problem in manufacturing, and no implication is to be made regarding its possible public health significance.

M18. Control of Types of Organisms in High Temperature Starters.

DAVE NUSBAUM AND WALTER V. PRICE, University of Wisconsin.

It is difficult for cheese makers to carry pure cultures of *S. thermophilis* and *L. bulgaricus* under factory conditions. Some Swiss cheese makers desire a mixed culture of the two organisms but experience difficulty in maintaining them in a single starter in the correct proportions. Brick cheese makers using these organisms should probably use a pure or practically pure culture of one or the other. In this study an attempt has been made to propagate and maintain as desired either a mixture or a pure culture of these organisms.

A technique was adopted which can be employed by any factory not equipped with laboratory facilities. By even slight variations either in incubation period, size of inoculation or both, a cheese maker can carry a mixed starter of these two organisms in any desired proportion. Such proportions can be regulated accurately enough for all practical purposes by simply observing the taste and titratable acidity of the starter from day to day. It was found that when a typical mixed starter, consisting of approxi-

mately equal numbers of rods and cocci, is propagated with 5 per cent inoculations and 30 hour incubation periods, it can be changed in a four day period to a mixture containing about 99 rods to each coccus. By using lighter inoculations and shorter incubation periods the same starter in the same time can be made essentially a pure culture cocci. These procedures have been repeated with similar results using several different strains of *S. thermophilus*. All cultures were carried in the same incubator at 37° C. Photomicrographs of stained preparations of each starter have been prepared to show the change in proportion of organisms at the end of each incubation period when the various cultural practices were employed.

Wisconsin operators obtain pure cultures at weekly or bi-weekly intervals from the University Department of Bacteriology. Many of them inoculate each day's starter directly from these cultures until a new supply is delivered. Work is now in progress which shows the length of time that mixed and pure cultures of these starter organisms will remain viable and active when stored at temperatures of 4° C., 20° C., and 37° C.

M19. Methods of Determining Chlorine in Milk and their Application in the Detection of Mastitis. GEORGE P. SANDERS, Bureau of Dairy Industry, U. S. D. A.

Direct titrations of chlorine in milk with silver nitrate and either potassium chromate (Mohr's method) or dichlorofluorescein indicator yield results which are so erroneously high and erratic that the use of either method is not considered justifiable. Digestion by boiling samples in the presence of an excess of silver nitrate together with nitric acid and potassium permanganate (open Carius method), followed by titration with potassium thiocyanate in the presence of ferric alum indicator (Volhard titration), yields quantitatively accurate results.

The latter method has been so simplified, by combining reagents and omitting digestion, that it is both accurate and easy. The recommended procedure is as follows:

Ten cubic centimeters of milk is measured accurately and to it is added a measured quantity of the 0.0291 *N* special silver nitrate solution described below, more than sufficient to combine with all of the chlorine; ordinarily 15 cc. is the amount used. The mixture is stirred slightly and about 100 cc. of water is then added; it is titrated immediately with a 0.0291 *N* (2.828 grams in 1 liter) solution of potassium thiocyanate. The number of cc. of silver nitrate solution minus the titration value, multiplied by 0.01, equals the percentage of chlorine.

Special silver nitrate solution: Exactly 4.944 grams of silver nitrate is dissolved in water; 200 cc. of concentrated nitric acid and 300 cc. of a saturated solution of ferric ammonium sulfate (alum) indicator are added and the mixture is cooled and made up to 1 liter. The solution is standardized against the thiocyanate solution before use.

A study of data obtained in periodic tests in quarter-udder samples of milk from 29 cows, beginning in most cases with first-calf heifers and continuing through more than one lactation, shows that the determination of chlorine is one of the best of the several tests used for the detection of mastitis. Milks with chlorine values above 0.15 per cent were in all cases mastitis-positive; values between 0.12 and 0.15 indicated either suspected or definitely positive cases. Clinical symptoms varied so widely in different quarters of the udder at the same milking that it was found very essential to test quarter samples rather than all the milk of a milking. After the cow's recovery from mastitis, the chlorine value of the milk, like the yield of milk, usually failed to return to the normal level during the same or succeeding lactations.

M20. Controlling the Fat Content of Swiss Cheese in Southern Wisconsin. WALTER V. PRICE, University of Wisconsin.

From July 1936 to June 1937, four analysts measured the daily variations in composition of milk, curd, whey and cheese and recorded observations of the quality of milk and cheese at each of four Swiss cheese factories. These data were obtained from more than 3,800 kettles. The object of this work was to ascertain the feasibility of controlling the fat content of Swiss cheese by analytical and standardizing methods.

The factors responsible for variations in cheese composition are discussed in this report and the limits of accuracy of standardizing methods are indicated. It seems apparent from this study that, although the composition of the kettle milk can be controlled, the unpredictable variations in cheese composition make it impractical at present to attempt to guarantee a minimum of 45 per cent fat in the dry matter of every wheel of Swiss cheese as long as present commercial grades are observed.

M21. Sodium per Borate as a Corrosion Inhibitor for Washing Powders. LAWRENCE L. LITTLE, Meadow Gold Milk Plant, Oklahoma City.

A study was made of the effect of varying amounts of sodium per borate in preventing the corrosion of tin and aluminum in five per cent solutions of sodium meta silicate, trisodium phosphate, and sodium carbonate. Amounts of sodium per borate ranging from five to ten per cent were found to be effective in preventing the corrosion of both tin and aluminum in solutions of sodium meta silicate, while corresponding amounts had no effect in preventing the corrosion of tin and aluminum in five per cent solutions of trisodium phosphate or sodium carbonate. However, combinations of sodium meta silicate and sodium per borate were found to be effective in preventing corrosion of tin and aluminum in solutions of trisodium phosphate and sodium carbonate.

Trisodium phosphate is rendered non-corrosive to both tin and aluminum by the addition of ten per cent sodium per borate, provided at least twenty per cent sodium meta silicate is included in the trisodium phosphate portion.

Sodium carbonate is made non-corrosive to both tin and aluminum when five per cent sodium per borate is added, provided the sodium carbonate contains a minimum of ten per cent sodium meta silicate.

M22. Sterilization by Irradiation—A Possible New Tool for the Dairy Industry. O. F. GARRETT AND R. B. ARNOLD, New Jersey Agricultural Experiment Station.

Recent development of lamps whose radiations have high bactericidal power has led to practical applications of this principle in certain fields of endeavor. The practical sterilization of the surfaces of meats and bakery goods has been successfully accomplished. Installations in restaurants and at soda fountains for the sterilization of drinking glasses have been successful. A battery of these lamps installed above a hospital operating table has resulted in a great decrease in post-operative infections. The practical sterilization of the air of rooms is being studied.

To determine whether this type of death-ray had a possible practical application in the dairy industry a number of preliminary experiments at the New Jersey Station have been completed. Various utensils and containers such as large dippers, pails, ice cream cans, 10-gal. milk cans, and glass milk bottles were seeded with bacteria and then exposed to radiation for various times of exposures. At the end of 3 minutes the 2-quart dippers were completely sterilized, the straight-sided 5-gal. ice cream cans showed 99% destruction and the 10-gal. milk cans showed 95% destruction.

Exposure of a seeded spray vat pasteurizer and a coil vat pasteurizer showed very good bactericidal action of the radiations.

These preliminary results suggest the possibility of practical application of this type of sterilization to the control of bacterial growth in dairy utensils and equipment, to the control of outbreaks of thermophiles, ropy organisms, etc., in dairy plants, to the sterilization of paper and glass milk bottles, and perhaps as a help to the control of disease in the dairy herd.

M23. Kefir Buttermilk. LLOYD A. BURNEY, Bureau of Dairy Industry, U. S. D. A.

A method has been worked out for making buttermilk by the use of kefir grains. The method for the most part consists of immersing kefir grains in milk near the surface for 24 to 48 hours at a temperature of 65° to 70° F. by enclosing them in a cheesecloth bag or by some other porous container.

The advantages of this method of preparing buttermilk are that the culture remains active indefinitely without much danger of contamination, very little equipment or technique is required, and the product produced is highly flavored. The flavor can be varied at will by varying the temperature and

time of incubation and the method of using the grains. Such variations in conditions can be so controlled as to give buttermilk of alcoholic, of mildly acid, or of highly acid taste.

M24. The Present Status of the Development of Fiber from Casein. EARLE O. WHITTIER, Bureau of Dairy Industry, U. S. D. A.

Casein fiber has been produced in Italy on a rapidly increasing scale for the past 2 years and production is now beginning in other countries. The fiber resembles wool, but may be produced of widely differing diameters, lengths, and physical characteristics. The casein required must be made under carefully controlled conditions such as already prevail in a considerable number of our domestic casein plants. One year's production of milk by an average cow (4,000 pounds) will furnish enough casein for 100 pounds of casein fiber.

M25. Whey Solids in Candy. BYRON H. WEBB, Bureau of Dairy Industry, U. S. D. A.

On the basis of experimental work in which whey solids have been incorporated in different types of candy, it appears probable that an important outlet for whey solids can be developed in the candy industry. Two of the three chief solid constituents of whey, lactose and protein, have been shown to be of distinct value in certain candies. Whey protein is of value in candy as an improver of body and flavor. In some candies in which whipped sweetened condensed whey is used, the whey protein is an important factor in foam production. Lactose in candy is essentially a substitute for sucrose and in such a rôle it pleasantly decreases the sweetness of the ordinary confection. The third whey solid, the salt, is of lesser importance and even limits the quantity of whey which may be used in certain candies.

Whey, chiefly in the form of sweetened condensed whey, has proved especially promising in the development of tentative formulas for caramels, fudge and toffee. Some progress has been made in the utilization of whipped sweetened condensed whey as a frappé for candy makers. Highly concentrated sweetened condensed whey with the lactose properly crystallized has been used as a major constituent of fondant. The usefulness of whey in fondant may be limited to colored goods because of its greenish yellow cast and tendency to darken with age.

It has been shown that whey solids can be used in candy, but to the candy manufacturer cost and convenience will be important factors entering any decision to use whey. Sweetened condensed whey probably is the most convenient economical and satisfactory form in which to process whey for the candy manufacturer.

M26. Effect of the Cold Storage Temperature, Pasteurization Treatment, and Homogenization Pressure on the Properties of

Frozen Condensed Milk. RAYMOND W. BELL, Bureau of Dairy Industry, U. S. Department of Agriculture.

Conditions which are optimum for the preservation of the flavor of frozen condensed milk of 8 per cent fat content may not be most favorable for the body of the product.

Best results were obtained when the condensed milk was (1) stored at minus 7° C., (2) heated to 76.5° C. and held 8 minutes, and (3) homogenized at 2,000 to 3,000 pounds' pressure per square inch.

M27. Consumer Preference as Related to the Analysis of Vanilla Ice Cream in Tennessee. THOS. B. HARRISON, H. B. HENDERSON, AND C. E. WYLIE, University of Tennessee.

Is there any relationship between the consumer preference for vanilla ice cream and the analysis of it? Does the consumer want the rich ice cream or is it more important for the flavor to be clean and the texture smooth? How much variation is to be found in Tennessee ice cream? A project is in progress at the University of Tennessee to determine the relationship of consumer preference to the analysis of ice cream.

Ice cream plant managers all over the state expressed a willingness to cooperate by sending one-gallon samples of vanilla ice cream and their laboratory record on fat, serum solids, sugar, gelatin, and eggs upon requests made by the secretary of the Tennessee Dairy Products Association.

Requests are made for the samples to be sent from six plants at one time. A pint sample is taken from each gallon for analysis, which includes the Mojonnier tests for fat and solids, the pH test by the Beckman meter, and the acid test. It was found that six samples are about all that the untrained, unprofessional judge of ice cream cares to pass judgment on at one time.

Stenographers, Extension staff members, Experiment Station workers, professors, and students are invited to express their preference on the six samples. They are asked to place the sample they like best first and the sample they like least at the bottom. Then they are to pick the second best and the next to the poorest. Then only two samples remain to decide upon. Such procedure makes their task less confusing. Each lot is judged by fifty or more people working independently of one another.

A table will be presented showing the results of this investigation as to formula, composition, and consumer preference. The forms used in recording the results and reporting to the cooperating companies will be shown.

M28. The Use of Moving Pictures in Ice Cream Investigations. W. H. REID, W. S. ARBUCKLE AND R. J. DREW, Missouri Agricultural Experiment Station.*

Preliminary studies have been made in regard to the use of ordinary

* Contribution from the Department of Dairy Husbandry, Missouri Agr. Exp. Sta., Journal Series No. 555.

colors and chromatic films taken with moving picture equipment showing the relation of variable mix compositions, effects of manufacturing procedure and subsequent treatment to which ice creams may be subjected.

This investigation has been limited to the application of moving pictures in studying the stability of ice creams. The ice creams and sherbets studied include those of common flavors, also fruit and nut ice creams.

The use of moving pictures permits acquisition of more complete detailed data than is obtainable when the usual procedure is followed. Availability of data so recorded emphasizes certain factors which may not otherwise be observed.

The report of this investigation will be illustrated by the use of moving pictures showing the effectiveness of this procedure.

M29. Application of the Phosphatase Test to Determine the Efficiency of Pasteurization of Ice Cream Mix. A. J. HAHN AND P. H. TRACY, University of Illinois.

Preliminary results of a study being made at this station have shown that the phosphatase test can be successfully used with certain limitations to determine the efficiency of pasteurization of ice cream mix.

Scharer's test[1] is being used for these determinations and a photoelectric procedure for determining color intensities.

Variations in temperature of pasteurization and in the holding period could be detected, while the use of raw ingredients as compared to pasteurized ingredients before pasteurization had no appreciable effect on the phosphatase content of the final pasteurized product.

Pure vanilla extracts added to the mix had no effect in the final results of the test, while imitation and artificial vanilla extracts increased the phenol value. The use of vanillin and coumarin crystals in ice cream mix, flavored to taste, produced striking results. Coumarin increased the phenol value over ten times that of the control sample, while vanillin produced a greenish tint which made it impossible to compare with the desired blue color.

Six different kinds of fruit flavored extracts were added to the ice cream mix and were found in five out of six cases to increase to a small degree the phenol value.

Three different kinds of cold pack fruits were added to the ice cream mix and in each case appreciably raised the phenol value of the test.

Storing mix during the aging period of two days at 40° F. decreased to a very small degree the phenol value of the test in the underpasteurized samples, but had no effect on the pasteurized samples. No change in the phenol value was noticed after the ice cream had been drawn from the freezer as compared to the aged mix. Storage in hardening room showed a slight decrease in phenol value for underpasteurized samples but no effect on pasteurized sample.

[1] JOURNAL OF DAIRY SCIENCE. Jan. 1938, p. 21.

M30. Influence of Certain Mix Components Upon the Rate at which Freezing Occurs in Ice Cream as Measured by the Dilatometer Method. W. C. COLE AND J. H. BOULWARE, University of California.

Dilatometer measurements were made on the rate at which freezing occurred in ice cream that was maintained during the observation at 2.5 degrees C. below the freezing point of the mix. For a given comparison it was necessary to adjust the freezing points of the mixes to the same value $\pm$ 0.05° C. This was done by adding sodium chloride in the proper amounts to those mixes whose original freezing points were above the lowest freezing point value in a given series of samples.

On the basis of this method the relative effectiveness of fat and milk-solids-not-fat in retarding the rate at which freezing occurred in ice cream was evaluated. It was found that the milk-solids-not-fat were more effective than fat in retarding the rate of freezing.

When these results were compared with the texture of ice cream made from the same mixes, the smoothness of the ice cream was improved to a greater extent by the milk-solids-not-fat than by the fat, provided ice crystal size was used as the basis of determining smoothness. Although deviations from this occurred when the organoleptic test was used as the basis of evaluating smoothness, the results from the two methods were generally in good agreement.

M31. A Study of Quality Variations in Summer and Winter Made Cheese. J. C. MARQUARDT, New York Agricultural Experiment Station.

Low quality in winter made cheddar cheeses causes numerous factories to operate at a loss during the winter period. The industry regards this as one of its main problems.

In New York, Wisconsin and the cheese sections of Canada the so-called winter cheese period extends from November 15th to May 21st. These dates may vary slightly with season. Data were collected in an organized manner regarding the quality of summer and winter made cheeses from the above mentioned sections. Experimental cheeses were also made to study these variations. The work thus far has revealed the desirability of expressing the degree of cheese flavor with the numerical score in comparing cheeses. The results obtained with the commercial and experimental cheeses indicate that the development of cheese flavor in summer made cheeses is much faster than in those made during the winter period. The numerical scores do not follow a comparable trend.

Cheeses made during both seasons were cured at temperatures derived from a cross index plan so that winter made cheeses were cured under summer conditions and vice versa. The cross index system supplied information on

curing temperatures beyond those normally encountered during the two seasons. These data are interesting and supply clues for curing procedures. They do not explain the variations obtained in winter and summer made cheeses. It is planned to cross index the temperatures at which milk is stored so that milk produced during both seasons will be subjected to comparable conditions. Increasing the calcium content of the milk increased the rate of breakdown in texture of cheeses made during both seasons.

M32. Starters Used in Wisconsin Brick Cheese Factories. WILLARD L. LANGHAUS, PAUL R. ELLIKER, University of Wisconsin.

In 1936 a survey of forty Brick cheese factories in Wisconsin revealed that a wide variety of starters were used to develop acid during the manufacturing process. A few operators carried starter cultures. Most of them, however, were using natural starters of various types. Troubles with starters and defective cheese were most commonly observed during the months of July and August. From the forty factories, observed in 1936, twelve were selected in August, 1937, for a more careful study, the results of which are reported here.

One day was spent at each of the twelve factories. Samples of starter, mixed milk delivered by each patron, and a composite sample of all milk delivered on that day were taken at each factory, iced and brought to the laboratory for analysis.

The approximate numbers and the dominant types of organisms in starter and milk were determined by means of a series of dilutions in litmus milk, followed by incubation at 20°, 37°, and 48° C., by means of Burri slopes and by microscopic examination. A week after the observations were made in each factory, a sample of cheese was obtained to determine the quality of the finished product.

Large numbers of thermoduric types of acid-producing organisms were found in the starters. Yeast, gas-forming organisms of the Escherichia-Aerobacter group, as well as other undesirable types were commonly present, sometimes in large numbers.

There was a rather close correlation between the quality of the starter, as determined by the types of organisms present, and the quality of the cheese obtained from the factory. When starters of good quality were used in milk of inferior quality the chances of producing a superior types of cheese seemed to be greatly improved. The results of this study indicate that better cultures and improved methods of propagating starter are badly needed in Wisconsin Brick cheese factories.

M33. Methods Which Help to Retain Fat in American Cheddar Cheese at High Temperatures. HARRY L. WILSON, Bureau of Dairy Industry, U. S. D. A.

A method has been developed for manufacturing American Cheddar cheese so that the fat will not leak out when the cheese is held at relatively high temperatures. The method consists of separating the cream from the milk by adjusting the cream screw of the separator so as to produce cream having a fat content of 40 per cent, heating the resulting cream to from 100° to 142° F. and homogenizing it at from 500 to 2000 pounds' pressure per square inch. If the cream is not heated to 142° F. before it is homogenized, it is heated to 142° immediately after homogenization, held 30 minutes, and standardized to the fat content desired for making cheese with pasteurized skimmed milk. Or the homogenized cream can be standardized with raw skimmed milk and the mixture pasteurized immediately by heating to 142° and holding 30 minutes.

From this point on it is necessary to modify the manufacturing method slightly. The finished product will have all the characteristics of a normal American Cheddar cheese, except that there will be no oiling off nor leakage of fat when it is exposed to temperatures as high as 85° F.

M34. X-Ray Diffraction Analysis of White Specks in Cheddar Cheese. S. L. Tuckey, H. A. Ruehe, and G. L. Clark, University of Illinois.

Babcock, Russell, Vivian and Baer in 1902 described the conditions favoring the formation of white specks during the ripening of cheddar cheese. Val Slyke and Publow in 1910 claimed that the white specks were calcium soaps formed as a result of the combination of fatty acids liberated by bacteria acting only at low temperatures.

By x-rays analysis it has been shown that the white specks isolated from well ripened cheddar cheese have the same crystal structure spacings as calcium lactate. A few of the "d" spacings are listed:

"d" spacings in Angstrom units white specks		"d" spacings in Angstrom units standard calcium lactate	
d_1	11.930	d_1	11.860
d_2	9.845	d_2	9.810
d_3	4.427	d_3	4.400
d_4	3.607	d_4	3.580
d_5	3.280	d_5	3.260
d_6	3.080	d_6	3.080

Since the "d" spacings are specific for the various substances, the white specks in cheddar cheese are apparently crystals or deposits of calcium lactate.

M35. Studies on the Ripening of Blue Cheese. C. B. Lane and B. W. Hammer, Iowa Agricultural Experiment Station.

Comparisons of cheese made from homogenized pasteurized milk and from homogenized raw milk have been continued. Pasteurization of the

milk should control certain defects sometimes present in cheese made from raw milk, especially during periods when the milk is of relatively poor quality. Cheese made from homogenized pasteurized milk did not show extensive fat hydrolysis of the odor of methyl-n-amyl ketone until after conspicuous growth of the mold, whereas cheese made from homogenized raw milk developed definite fatty acid and ketone flavors very early. Approximately 6 months of ripening were necessary before the cheese made from homogenized pasteurized milk developed a satisfactory blue cheese flavor; while only about 3 months were required with cheese made from homogenized raw milk.

The addition of a small amount of salt (2 per cent of the estimated weight of curd) to the curd, immediately before hooping, appeared to be a desirable procedure in the manufacture of blue cheese from homogenized milk. Cheese made from salted curd usually developed a more rapid and extensive mold growth than cheese made from unsalted curd, presumably due to the comparatively open texture, and the color was commonly less yellow.

Cheese made from milk produced by cows feeding on a ration high in cracked soybeans was regularly less colored than cheese made from ordinary milk. No definite difference in the flavor of the two types of cheese was apparent.

Loaf cheese, weighing about 5 pounds each, were made in special forms. The cheese ripened normally and the quality compared favorably with that of normal shaped cheese. The loaf cheese appears to be more practical than the usual cheese for retail stores where small slices are cut from a cheese.

M36. Studies on the Vitamin *A* Content of Cheese. I. L. HATHAWAY AND H. P. DAVIS, University of Nebraska.

The vitamin A content of twenty-two kinds of cheeses was studied by feeding these cheeses to rats whose body stores of vitamin A had been exhausted by being fed a vitamin A deficient diet. Twelve experiments were made in which approximately eleven hundred rats were used. From the data obtained it was evident that all cheeses do not have the same vitamin A value. Certain kinds appear to be good sources of this vitamin while other kinds are only fair to poor sources.

M37. Plant Experience with Sonic Soft Curd Milk. LESLIE A. CHAMBERS, Eldridge Reeves Johnson Foundation and University of Pennsylvania.

Homogenization of milk with the 360 cycle sonic oscillator has been studied under operating conditions in a few plants over periods of time ranging from three weeks to about one year. The data show that a unit handling milk at 250 gallons per hour with a power consumption of 4 kilo-

watts will reduce the fat particle size sufficiently to eradicate creaming. Simultaneously, there is a reduction of at least 50 per cent in curd tension with a final value never greater than 30 grams. Furthermore, there is a reduction of 50 per cent or more in the residual bacterial count after pasteurization and an improvement in both body and apparent flavor of the product.

Sonic homogenization has been compared directly with both high and low pressure methods. It has been found that both the sonic apparatus and low pressure homogenizers permit recovery of a much larger proportion of fat from returned milk than is the case when pressures above 2000 pounds are employed.

It should be emphasized that the terms "homogenized milk" and "soft curd milk" are not synonymous, since it is possible to obliterate creaming without having much effect on the curd tension. Many homogenized milks now marketed should not be called "soft curd."

The leucocytic sediment normally found in milks homogenized under conditions which produce the soft curd quality does not appear in bottles of sonized milk. This is possibly due to the fact that sonic cavitation completely disintegrates the white cells.

There is evidence that the phosphatase test is not valid when applied to homogenized milks since the processing apparently inactivates the enzyme wholly or in part.

M38. The Digestibility of Natural and Processed Soft-Curd Milks. C. C. Flora and F. J. Doan, Pennsylvania State College.

The digestibility of natural hard-curd and soft-curd milk as well as that of soft-curd milk produced by boiling, by homogenization, by base exchange treatment, by enzymatic digestion, etc., has been determined, using an *in vitro* method developed by the authors but based on that of Doan and Welch. This method gives an indication of the rate of peptic breakdown (stomach emptying) and also of tryptic digestion which follows. The results obtained *in vitro* have been checked by feeding rats, kept for a period without food, and noting the progress of digestion by post-mortem examination of the digestive tract.

Briefly, the *in vitro* method consists in coagulating milk in small flasks, treating the coagulum with a digestion mixture of HCl and pepsin, agitating it mildly in an incubator at 37° C. and examining replicate flasks at definite intervals. The pH is adjusted periodically, beginning with approximately pH 6.0 and lowering to about pH 3.5 at the end of 2½ hours. Peptic digestion is measured by making nitrogen determinations on the material from the flasks which passes through a 12-mesh screen, at hourly intervals. At the start of the fourth hour the contents of the flasks are adjusted to about pH 7.0 with NaOH and trypsin is added. The pH is raised to about 8.1

at the end of the fourth hour and tryptic digestion is noted by making nitrogen determinations on tri-chlor-acetic acid filtrates at hourly intervals. In some cases sodium tungstate filtrates have been used in an effort to determine the degree of protein degradation.

Preliminary results indicate that natural soft-curd milk digests considerably faster than natural hard-curd milk in both peptic and tryptic digestion. Boiling milk retards the action of pepsin on the protein but the mechanism of physical breakdown in the stomach is more rapid and complete, so that by the method used, more rapid peptic digestion is indicated. Trypsin action is accelerated by the boiling of milk and total digestion at 6 hours is noticeably in advance of the unboiled milk.

The data covering other types of soft-curd milk are not sufficient to warrant conclusions at the time this abstract is being written but will be available for interpretation at the meetings.

M39. The Relationship Between Curd Tension and Curd Size. LESLIE A. CHAMBERS AND IRVING J. WOLMAN, Eldridge Reeves Johnson Foundation and University of Pennsylvania.

Apparatus has been developed for studying *in vitro* curd formation under controlled conditions approximating those in normal and pathological human stomachs. With the new technique it is possible to measure the total curd surface presented for gastric digestion and thus to evaluate measurements of curd tension as indices of digestibility.

When curd surface areas are compared with the usual curd tensions there is general agreement with the theory that curd tension is an index of the rate of gastric clearance, but there are exceptions to this rule in the cases of milks subjected to drastic additions or subtractions. Thus, diluted milk while lowered in curd tension, gives about the same surface number as the undiluted base.

We have examined several hundred samples including most of the available types of certified, raw, pasteurized, homogenized, sonized, enzyme treated, base exchange processed, condensed, evaporated, and dried milks as well as a wide variety of modifications used in the feeding of infants. The data permit a preliminary evaluation of the curd-forming properties, free from any limitations of the curd tension test.

M40. Artificial Gastric Digestion of Milk. MAURICE E. HULL, M. & R. Dietetic Laboratories, Inc., Columbus, Ohio.

Since the development and use of the Hill test for determining curd tension of milk there has been an extensive use of this method by the dairy industry. It has caused an advance in the knowledge of how milks behave in the animal stomach. Milks of low curd tension have been shown to be beneficial in human digestion. However, it has been difficult to measure

digestion. In order to shed some light on gastric digestion of milks the author has developed an artificial method of studying this function of the stomach.

The method was designed for the formation of the curd at the optimum reaction for the production of an enzyme curd followed by changing this reaction to one for optimum pepsin digestion. Gentle agitation was maintained throughout the method. The degree of digestion being measured by a protein determination of the filtered digestion mixture.

GENERAL SESSION, WOOSTER

3. **The Inter-Relationship of Production and Manufacturing Research in the Development of the Dairy Industry.** ERNEST L. ANTHONY, Dean of Agriculture, Michigan State College.

The dairy industry is the wonder child of American Agriculture. Less than a century ago it was unknown, unhonored, and rather despised as an occupation or activity,—principally limited to women, the kitchen, and the backyard. From this humble and insignificant start, it has steadily and with increasing momentum come from behind to be the present day leader of the several important phases of American Agriculture.

This phenominal advancement or change has been largely the result of the consistent application of the sciences to its problems. It is no idle boast to say that no other phase of agriculture has been so completely influenced and guided by scientific principles as has the dairy industry. These principles have been adopted and applied through the medium of research. This research has not been the development in the production field or the manufacturing field alone but fortunately has been advanced in both fields through close coordination. This close coordination or inter-relationship has made possible a united front on the problems of the industry. The research work on vitamin introduction through production methods and its retention through processing and distributing procedure; the studies in quality incorporation in production and its value in manufacturing practices; the researches in consumer demand and market limitations and the adjustment in production methods to satisfy the problem are only a few typical examples of the close inter-relationship which has been so important in the dairy development of the last half a century.

PAPERS READ BY TITLE

1. **The Relation of Milking Machines to the Incidence of Mastitis.** EDWARD B. MEIGS, HENRY T. CONVERSE, Division of Nutrition and Physiology, and LLOYD A. BURKEY, MORRISON ROGOSA, AND GEORGE P. SANDERS, Bureau of Dairy Industry, U. S. Department of Agriculture.

The introduction of machine milking in a herd of cows maintained for nutrition work by the U. S. Department of Agriculture was followed by a severe outbreak of mastitis. During the outbreak and after it had subsided, the chlorides and the numbers of leucocytes and bacteria were determined in numerous samples of milk while the cows were on various modifications of machine milking and on hand milking.

The modifications of machine milking chiefly studied were "severe machine milking," in which the vacuum used was high, the machines were left working on the udders for rather long periods, and the cows were stripped by massaging the udders while the machines were still working on them; and "mild machine milking," in which the vacuum and periods of milking were lessened and the cows were stripped by hand. Some of the cows milked by all methods had had previous cases of mastitis, and some had not.

In the milk of the cows milked by hand, the chlorides and the numbers of leucocytes and bacteria have remained at low levels and the milk yields have been normal in almost all instances, whether or not the cows had had previous cases of mastitis. For the cows subjected to severe machine milking, the results have been variable; but, in almost all instances, high leucocyte counts have appeared in the course of a few days or a few weeks, which usually were not accompanied immediately by increased bacterial counts. After a further variable interval of several days or weeks, large numbers of bacteria have appeared in the milk in the majority of instances, accompanied by a great increase in chloride content, rapid reduction in milk yield, and other signs of acute mastitis. A change to hand milking was uniformly followed by a rapid reduction in leucocytes and chlorides, and, in the next lactation period, by a marked recovery in milk yield and by a return of the milk to normal in practically all respects. Mild machine milking has not resulted so far in any severe cases of mastitis, though the leucocytes, and sometimes the chlorides, have tended to be definitely higher than in the case of hand milking.

The tendency of machine milking to produce high leucocyte counts and increased chloride content without accompanying high bacterial counts, and the tendency of hand milking to produce opposite effects, constitute strong evidence for the view that machine milking may sometimes have a mechanically injurious effect on the secretory membranes of the udder. The frequency with which these symptoms of injury have been followed by acute mastitis in the case of severe machine milking indicates that the injury, if carried far enough, renders the udder tissues a better medium for bacterial growth.

It should be emphasized that only one type of milking machine has been studied so far, and that no severe cases of mastitis have followed its use, except under the conditions of "severe machine milking" or conditions approaching thereto. The results should by no means be taken to prove that machine milking in general will be accompanied by a greater incidence of mastitis.

2. Sudan Grass Hay vs. Clover Hay for Dairy Cows. C. E. WYLIE AND S. A. HINTON, University of Tennessee.

Years of drought frequently require the use of emergency crops in feeding dairy herds. Sudan grass is such a crop since it may be grown late in the summer. It makes a rapid growth and great tonnage. It is of value, therefore, to obtain information on its feeding value even for a short time.

During the winter of 1936–37 an experiment to determine the value of Sudan grass hay for dairy cows was set up at the University of Tennessee. Two groups of Jersey cows, four cows in each group, were used. Group I was fed a ration of grain, silage, and Sudan grass hay. Each cow received 20 pounds of silage daily. Grain was fed each cow at the rate of one pound of concentrates to three pounds of milk produced. Each group was fed all the hay that they would eat. Accurate weights of the amounts of feed fed and refused was kept and recorded daily. At the end of forty-five days the kind of hay that each group was fed was reversed, Group I receiving Sudan grass hay and Group II receiving clover hay. Milk weights were kept and the milk was tested one day each week for butterfat. The cows were weighed one day each week and weights recorded. On the basis of this short time experiment, Sudan grass hay was worth approximately five-sixths as much as clover hay as a feed for dairy cows. The cows in both groups maintained normal body weight during the experiment. The cows were never off feed and kept in good physical condition. All of the cows bred and calved normally.

3. The Extraction and Assay of the Hormones of Cattle and Sheep Pituitaries. A. J. BERGMAN AND C. W. TURNER, University of Missouri.*

It has been shown that the milk yield of dairy cattle can be increased by the injection of certain anterior pituitary extracts. Since it is assumed that the hormones of the pituitary directly (lactogenic) and indirectly (thyrotropic, parathyrotropic, adrenotropic, carbohydrate, fat and protein metabolism) influence lactation, considerable attention has been given to the chemical extraction, separation, purification and biological assay of these factors. In order to investigate the relation of the several hormones to lactation, it is desirable to have available assayed pituitary extracts.

All of the hormones mentioned have not been separated nor have assay methods been developed. However, assay techniques for the lactogenic, thyrotropic, carbohydrate metabolism and gonadotropic hormones have been developed and the units defined. For assay of the lactogenic hormone the common pigeon is used; for the thyrotropic and carbyhydrate metabolism the immature male guinea pig. Since the gonadotropic hormone is considered as

* Contribution from the Department of Dairy Husbandry, Missouri Agr. Exp. Sta., Journal Series No. 561. Aided in part by a grant from the Committee on Research in Endocrinology of the National Research Council.

a contaminant as far as lactation is concerned, its presence must be determined. For this test animal the day old chick is used.

The anterior lobe of both sheep and cattle pituitaries have been used as a source of the hormones. The anterior lobes are ground, dried with acetone and assayed for the lactogenic, thyrotropic, carbohydrate metabolism, and gonadotropic content. Approximately 85–90 per cent of the inert material is then removed by extraction with alcohol at pH 9–10. This extract referred to as the *initial*, is again carefully assayed. The lactogenic hormone (I) is then separated from the thyrotropic, carbohydrate metabolism and gonatropic hormones (II). It (I) is then further purified and upon assay has been shown to be relatively free of other hormones. The fraction containing the thyrotropic, carbohydrate metabolism, and gonadotropic (II) is then assayed. Further attempts are being made to separate this fraction. The lactogenic (I) potency has been increased from 500 to 6600 units per gram. The fraction containing the thyrotropic, carbohydrate metabolism and gonadotropic (II) has been increased as follows: thyrotropic, 50 to 4000 units per gram; carhohydrate metabolism 20 to 660 units per gram; and the gonadotropic from 250 to 10,000 units per gram.

4. Relation of Lactic Acid and Glucose of the Blood and Glycogen in the Mammary Gland to Milk Secretion. W. E. Petersen, J. C. Shaw, University of Minnesota.

It has been shown recently that the active mammary gland removes both lactic acid and glucose from the blood. From this it was postulated that glucose and lactic acid are used by the mammary gland for the synthesis of lactose. This hypothesis was proven to be correct by Peterson and Shaw who succeeded in synthesizing lactose *in vitro* from glucose plus lactic acid and mammary gland tissue. Lack of a definite relationship between the amounts of glucose and lactic acid removed by the mammary gland from time to time suggest some other mechanism is involved in the process of lactose synthesis.

These variations could be accounted for by a storage of carbohydrate in the gland. Analysis of both lactating and non-lactating glands showed an average of 0.2 per cent of glycogen on the basis of the total weight of the gland. The glycogen, temporarily stored in the gland, is therefore probably built up from the blood carbohydrate when large amounts are taken out by the gland and becomes a source of the lactose precursors when small amounts of carbohydrate are taken out of the blood.

5. The Carotene Requirement of Dairy Calves. Ruel E. Ward, S. I. Bechdel, and N. B. Guerrant, Departments of Dairy Husbandry and Agricultural and Biological Chemistry, Pennsylvania State College.

In an effort to determine the carotene requirement of growing calves, twenty-seven animals (20 Holsteins and 7 Guernseys) have been fed varying amounts of carotene from the following sources: Alfalfa hay, timothy hay, corn silage, alfalfa silage, yellow corn, and a commercial carotene preparation (Puratene). The carotene content of the different materials was determined by the Struve modification of the Guilbert method.* When alfalfa hay or Puratene (carotene in cottonseed oil) was used as the source of carotene, 12 to 14 micrograms of carotene per pound body weight per day was sufficient to prevent the symptoms of vitamin A deficiency. These results agree very well with those reported by Hart and Guilbert. When timothy hay or corn silage was given as the source of carotene the requirements were about 25% higher than the values mentioned above. The results to date with alfalfa molasses silage indicate that the requirement may be even greater than this latter value. The differences noted above are probably due to the fact that with some materials the method of carotene estimation is complicated by the presence of carotenoids other than beta carotene.

Increased growth or improved well being in Holstein calves did not result when the carotene was supplied above 20 to 30 micrograms per day per pound body weight. The results to date indicate that minimum requirements of carotene for Guernsey calves are not appreciably higher than for Holstein calves. The Guernseys, however, appear to be more subject to intestinal and respiratory disorders at low carotene intakes. The general results of the experiment indicate that calves have a slightly higher requirement for carotene in winter as compared with the summer months. Work with older animals indicates that heifers, one to two years of age, will probably show little or no carotene deficiency in the winter months if they have been on good pasture during the previous summer.

6. Revised United States Standards for Quality of Creamery Butter. ROY C. POTTS, Principal Marketing Specialist, United States Bureau of Agricultural Economics.

The Revised Tentative United States Standards for Quality of Creamery Butter became effective April 1, 1938 by approval of Dr. A. G. Black, Chief of the Bureau of Agricultural Economics.

By the old standards the five factors, flavor, body, color, salt, and package, were each given an arithmetical rating and the total of those ratings became the final score. Under the Revised Standards the factor of package is eliminated from consideration entirely. The factors of flavor, body, color, and salt are each rated entirely independent of the other, and the final score is determined by the application of a rule and a schedule for defects in body, color, and/or salt which are permitted in butter of a particular flavor rating and do not require the final score to be below the rating given to flavor.

* Permission obtained from Oscar H. Struve, Chemist, Eastern States Feed Mills, Buffalo, New York, to use the method in this study.

The official United States score of individual sample of creamery butter under the Revised Standards is determined by the following general rule: "The official United States score of an individual sample of creamery butter shall be determined by deducting from the flavor rating of the sample the amount that the total ratings of the defects in body, color, and salt is in excess of the ratings for defects permitted in these factors for butter of the particular flavor rating, the official United States score to be experssed as a whole number by lowering any half score to the next lower full score."

To properly apply the Revised Standards, a grader must know the rating established for each identified flavor and he must be able to identify each flavor correctly with respect to its character and its degree or extent of development. Without such knowledge of the various identified flavors a grader would not be able properly to apply the standards for he would not know them. The grading of butter according to these standards, therefore, is not a job for a layman, who has a general knowledge of butter and a generally good taste sense, but if it is to be expertly and properly done, it requires the expert knowledge and the expert experience of a completely and competently trained personnel.

7. **Effect of Temperature and Composition Upon the Physical Properties and Dipping Qualities of Ice Cream.** W. H. E. Reid, R. J. Drew and W. S. Arbuckle, University of Missouri.*

This study treats with the composition of the ice cream mix and the effect of serving temperature of vanilla ice cream upon the crystalline structure, stability, consumer acceptance, dipping and keeping qualities of ice creams.

Ice creams varying in fat content from 12 to 16 per cent; serum solids content from 9 to 15.5 per cent; sugar content from 12 to 18 per cent and gelatin content from .20 to .50 per cent were observed at the serving temperatures of 6, 10, 14 and 18 degrees Fahrenheit.

It was observed that as the serum solids of the mixes were increased there was a relative increase in the pH. Variation in the composition of the mixes had no marked effect upon the surface tension. Increasing the solids of the mixes resulted in a relative increase in the viscosity.

The serving of the ice creams at a temperature of 10 degrees Fahrenheit was considered desirable from the consumer's viewpoint. Ice creams containing 14 per cent fat, 13 per cent serum solids and 14 per cent sugar were preferred of the series of mixes studied.

Microscopic examination of the ice creams indicated that as the percentage of fat, serum solids, sugar or gelatin was increased the ice crystals appeared relatively smaller. Macroscopic pictures revealed that increased fat and gelatin percentages increases the stability, while the effect of varia-

* Contribution from the Department of Dairy Husbandry, Missouri Agr. Exp. Sta., Journal Series No. 557.

tion in serum solids and sugar content on stability was influenced greatly by the serving temperature.

Dipping studies show that the serving temperature and composition of the mix affect the number of scoops secured per gallon. The greater number of scoops of ice cream was obtained at a temperature of 6 degrees Fahrenheit. The least number of scoops was usually obtained as the serving temperature was increased, there being a slight decrease in the number of servings per gallon.

The keeping qualities of all ice creams was most favorable when held at a temperature of 6 degrees Fahrenheit. Sandiness did not become apparent in the ice creams containing 13.50 per cent serum solids even when held at the different serving temperatures for three weeks. However, the mixes containing 15.00 per cent serum solids showed indications of sandiness when aged two weeks.

Ice creams served at 10 degrees Fahrenheit had the most desirable eating qualities although a temperature of 14 degrees Fahrenheit was considered desirable. Ice creams served at 6 degrees were described as being too cold with the flavor submerged.

8. A Comparative Study of Metal and Glass Petri Dish Covers. HERBERT JENKINS, New England Dairies, Inc.

In commercial laboratories where large numbers of standard plate counts are made daily, the breakage of petri dishes is an expense item to be considered. In order to eliminate a portion of this breakage, a search was made for a substitute for the glass cover. Obviously there could be no substitute for the glass bottom.

Experimental work was undertaken, first, to find a material for the cover which would be non-breakable; second, to determine whether this material would give the same results bacteriologically as glass.

A metal aluminum cover was finally adopted. Metals other than aluminum proved unsatisfactory because of appearance, rusting, warping, weight, discoloration, or the fact that they did not take identification marks easily. Covers of special paper were eliminated because of their expense and the fact that they allowed the agar to dry. Standard plate counts were made in duplicate, using glass and aluminum covers on more than 2,000 samples of milk of varying quality. No difference in the counts, other than the usual variations encountered with the standard plate method, was observed whether glass or aluminum covers were used.

Since results are the same with aluminum, as with glass covers, aluminum petri dish covers have several distinct advantages:

1. They are non-breakable and practically indestructible. For this reason they will last indefinitely, making the unit cost very low.

2. Their original cost is approximately one-third the amount of the pyrex cover.

9. Summary of Experiment with the Delaval Standardizer. J. H. FRANDSEN, Massachusetts State College.

1. Standardization reduces the amount of visible sediment in milk.

2. In general, standardization increases fat and total solids and decreases specific gracity.

3. Standardization has little effect upon bacteria count.

4. Standardized milk tends to have a better flavor than milk of the same age not standardized.

5. Standardization with a mechanical standardizer is more practical and economical than standardization by siphoning or foremilking.

10. Methylene Blue Reduction Time as an Indication of the Suitability of Milk for the Manufacture of Swiss Cheese. A. B. EREKSON, C. A. ECKBURG AND E. LEE, The Borden Company.

From two to eight wheels of Swiss cheese were manufactured daily with a few short interruptions in one factory in Clark County, Wisconsin, during the period April 1, 1935 and March 31, 1937. A total of 2463 cheeses were included in the study. Each kettle of milk was sampled before the starter was added and methylene blue reduction tests were made under carefully-controlled conditions. A complete set of records was kept on the manufacturing procedure and the quality of the cheese. The tabulated results indicate a very definite relationship of methylene blue reduction time of the milk to the quality of the cheese with a decided tendency toward better cheese as the reduction time increased up to six hours. The results show that when the reduction time was less than three hours, only one cheese in every 10.08 manufactured was above a "C" in grade, while when the reduction time was over three hours, one cheese in every 3.88 made was either a "B" or an "A" grade.

11. Casein Milk Fat as a Foam Depressant in Casein-Clay Slips. G. A. RICHARDSON AND N. P. TARASSUK, College of Agriculture, Davis, California.

The authors have previously concluded that the relationship between the fat content of casein and its foaming tendencies was somewhat obscure.[1] They later reported that oxidized fat is much more effective in preventing foaming of casein-clay slips than fresh fat.[2] It was postulated that this might account for the decrease in foaming tendency of casein on aging.

Additional studies confirmed this theory and showed that the physical and chemical condition of the fat plays the major, if not the only, rôle in the non-foaming tendency of casein-clay slips.

The spreadability of fresh milk fat on water, sodium casein solutions, and casein-clay slips shows a much lower value than does milk fat which has

[1] JOUR. DAIRY SCIENCE, *20*, 449, 1937.

[2] Proc. 23rd Annual Meet, Western Div. Amer. Dairy Sc. Assoc., pp. 70–78, 1937.

undergone chemical deterioration. This fact explains the foam-depressing action of the fat of commercial casein.

12. **The Relationship of Mastitis Milk and Soft-Curd Milk to the Manufacture of Swiss Cheese.** KENNETH J. MATHESON, LLOYD A. BURKEY, GEORGE P. SANDERS, AND ROBERT R. FARRAR, Bureau of Dairy Industry, U. S. Department of Agriculture.

In order to study the effects of mastitis milk and soft-curd milk on the manufacture of Swiss cheese a detailed survey was made of the milk from individual cows. As a result of this survey the milk was divided into four general groups, as follows: (1) Normal milk; (2) Mastitis milk; (3) Soft-curd milk with slow rennet coagulation, not mastitis; and (4) Normal low and high rennet-curd-tension milks.

As a result of manufacturing cheese from these types of milk, the following conclusions are drawn:

That mastitis milk causes the cheese to overset more than normal milk.

That there is evidence that the mastitis milk has an inhibitory effect upon the development of the lactobacillus (39a).

That there are more glass defects in the normal-milk cheese than in the mastitis-milk cheese.

That cheese made from normal milk has a lower percentage of water than that made from mastitis milk, or with the mixture of mastitis and soft-curd milks.

That the coagulation period is lengthened by the use of mastitis milk as compared to normal milk.

That grades of cheese from mastitis milk, from the mixture of mastitis milk and soft-curd milk, and from the soft-curd milk alone, are better than those of cheese from normal milk.

Of the cheeses made from milk produced by cows free of mastitis, the low rennet-curd tension milk cheese was higher in moisture, softer in texture, and poorer in quality than that made from high rennet-curd-tension milk.

It is to be understood that this question has been attacked solely as a research problem in manufacturing, and no implication is to be made regarding its possible public health significance.

13. **Texas One Day Dairy Shows.** G. G. GIBSON AND E. R. EUDALY, Texas A. & M. College.

The one day Dairy Show or "Dairy Day" was the result of a demand on the part of dairymen, county agents and representatives of milk plants for a program that would recognize excellence in dairy type, production and products.

In planning the Dairy Shows or "Dairy Days" the idea of having a program that would interest both the dairyman and his family was kept in mind.

The main feature of the day was the cattle show. Cattle were classified into Class A, B and C. Ribbons were awarded for each of the classes. At each show the best female and best bull were selected. Certificates were awarded where animals met certain standards of type and production.

A Dairy Cattle Judging Contest for 4–H Club members, F.F.A. members, men and women was carried along with the classification of the cattle. A Dairy Products Contest for women was also included. Samples of milk, cream and butter were scored. Between classes short talks were given by men from Texas A. & M. College and others dealing with problems that concerned the dairymen in that area.

In planning the dairy days a series of preliminary meetings had been held at which committees were appointed to handle the arrangements for each Show. It was left up to the various committees to work out a program for their Show that would best serve their interests.

14. **The Texas Trench Silo Program.** G. G. Gibson, Texas A. & M. College.

While it has been known for many years that feed can be stored satisfactorily in a trench silo, no concerted effort was made in Texas to bring about a wider use of the trench silo until 1932. In 1932, 523 trench silos were reported by county agents. In 1937 there were 9,483 trench silos containing almost 1,000,000 tons of silage reported in Texas.

In order to arouse interest in and to sell the idea to farmers, several methods have been employed:

(1) Trench silo demonstrations have been set up in various parts of the county. The County Agent arranges a meeting at the trench at time of filling. Other meetings are arranged at the trench when the silage is being fed so that farmers will have an opportunity to see the silage being used.

(3) Trench silo posters have been prepared.

(4) Chambers of Commerce and other organizations have sponsored contests within counties and within certain sections of the state based on increasing the number of trench silos. Other counties have increased the number of trench silos through the effort of the local committees.

(5) Commissioners' Courts in a number of counties have rendered assistance by making equipment available for the construction of trench silos. In the ranch country, equipment used for building tanks in connection with the range program is available for trench silo construction.

(6) The fact that trench silos are adaptable to any kind of conditions and practical for any farm has been kept uppermost at all times. It has been demonstrated that all kinds of crops in addition to regularly recognized silage crops can be stored in a trench silo. Many trenches have been filled in Texas with whole bundle feed so that it is possible for a farmer to have silage who does not have any equipment of any kind for cutting or handling the feed.

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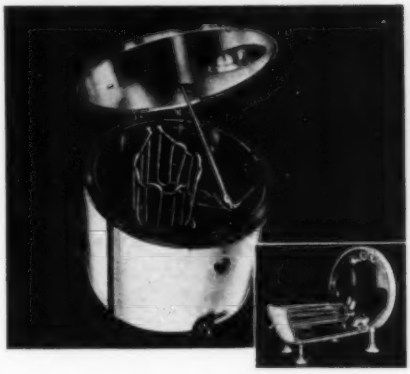

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